



SUPPLY CHAIN

4091-500 STOCKTON (SMF2), CA

96530402

October 5, 2022

Mariah B. Meyer
8131 Metcalf Avenue, Suite 300
Overland Park, KS 66204

PROJECT MANUAL

**WALMART SUPPLY CHAIN
STOCKTON (SMF2), CA
Facility Number: 4091-500**

Project Number: 96530402

October 5, 2022

For

**WAL-MART STORES, INC.
INDUSTRIAL DEVELOPMENT
2608 SE J Street
Bentonville, Arkansas 72716-0310**

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Supply Chain

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ARCHITECT OF RECORD

Mariah B. Meyer
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Architect of Record _____ Date

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STRUCTURAL ENGINEER OF RECORD

Joseph N. Flanagan
930 Central Street
Kansas City, MO 64105

Structural Engineer of Record Date

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FIRE PROTECTION ENGINEER OF RECORD

Christopher J. Culp
8345 Lenexa Drive, Suite 300
Lenexa, KS 66214

Fire Protection Engineer of Record

Date

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MECHANICAL ENGINEER OF RECORD

Michael Dean Schaefer
8345 Lenexa Drive, Suite 300
Lenexa, KS 66214

Mechanical Engineer of Record

Date

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ELECTRICAL ENGINEER OF RECORD

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Lenexa, KS 66214

Electrical Engineer of Record

Date

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
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
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
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SECTION 05510 (05 5100) – METAL STAIRS WITH HANDRAILS – Revise Entire Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Service-type stairs with concrete pan treads.
 - 2. Industrial-type stairs with steel grating treads.
 - 3. Steel tube handrails and railings attached to metal stairs.
 - 4. Steel tube handrails attached to walls adjacent to metal stairs.
 - 5. Railing gates at the level of exit discharge.
- B. Stairs and stair components may be manufactured and pre-assembled (drop-in) or shop-fabricated or assembled in the field at Contractor's option.
- C. Related Requirements:
 - 1. Section 03310 - Cast-In-Place Structural Concrete. Field-poured treads and landings.
 - 2. Section 05120 - Structural Steel: Attachments to building framing.
 - 3. Section 05500 - Metal Fabrications: Building support structure and miscellaneous framing fabrications.
 - 4. Section 05520 - Metal Pipe and Tube Railings: Stair railings.
 - 5. Section 09900 - Paints and Coatings. Field-applied finishes.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A 117.1 - Standard for Accessible and Usable Buildings and Facilities.
- C. ASTM International (ASTM):
 - 1. ASTM A 36 - Carbon Structural Steel.
 - 2. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A 366 - Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled.
 - 4. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 5. ASTM A 513 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
 - 6. ASTM A 570 - Steel, Sheet and Strip, Carbon, Hot-Rolled.
 - 7. ASTM A 569 - Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled.
- D. American Welding Society (AWA):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- E. Americans with Disabilities Act (ADAAG).
- F. Steel Structures Painting Council (SSPC):
 - 1. SSPC-SP3 - Power Tool Cleaning.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 01330.

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- B. Shop Drawings: Stair plans, elevations, details, methods of installation and anchoring.
 1. Show members, sizes and thickness, anchorage locations and accessory items.
 2. Furnish setting diagrams for anchorage installation as required.
 3. Provide calculations stamped by a structural engineer registered in the jurisdiction in which the project is located.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for metal stairs specified in this Section to be installed by firm with minimum of 5 years consecutive metal stair erection experience.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.
- C. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Design and Fabrication Standards:
 1. Fabricate stairs in accordance with the recommendations of "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP-510, for class of stair designated, unless more stringent requirements are indicated.
 - a. Preambled Stairs: Service class.
 - b. Industrial-Type Stairs: Industrial class.
 2. Fabricate railings in accordance with the recommendations of ANSI/NAAMM AMP-521. Finish joints in railings accordance with the following National and Ornamental & Miscellaneous Metal Association (NOMMA) standards:
 - a. Service Stairs, Guard Rails in Non-Public Spaces: Type 3
 - b. Industrial Stairs and Non-public Use Stairs: Type 4
 3. Provide same level of quality for railings guarding floor openings as railings connected to stairs serving opening.
 4. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - a. Service class, unless otherwise indicated.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Packing and Shipping: Deliver stair and rail components in manufacturer's pre-bundled protective wrapping, clearly labeled for stair type and location in building.
- C. Storage and Protection: Store stair and rail components above ground, protected from exposure to the elements and from physical damage caused by other construction activities.

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND REGULATORY REQUIREMENTS

- A. Structural Performance of Stairs: Stairs shall withstand the following structural loads without exceeding the allowable design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component:
 - 1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lb/sf and concentrated load of 300 lbf applied on an area of 4 square inches. Concentrated and uniform loads need not be assumed to act concurrently.
 - 2. Stair Framing: Capable of withstanding stresses resulting from loads specified in addition to stresses resulting from railing system loads.
 - 3. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.
 - 4. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Structural Performance of Handrails and Railings: Handrails and railings shall withstand the following structural loads without exceeding the allowable design working stress of materials, including handrails, railings, anchors and connections.
 - 1. Top Rail of Guardrail: Capable of withstanding a concentrated load of 200 lbf applied in any direction and a uniform load of 50 lbf/ft applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.
- C. Regulatory Requirements: Comply with applicable provisions of local building code, ADAAG and ANSI A117.1 as applicable for stairs and handrails.

2.2 MATERIALS

- A. Steel Shapes and Plates: ASTM A 36.
- B. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- C. Steel Tubing:
 - 1. Structural Use: ASTM A 500, Grade C.
 - 2. Non-Structural Use: ASTM A 513, hot rolled or coiled rolled (mill option).
- D. Steel Sheet:
 - 1. Structural Use: ASTM A 570 (hot rolled) or A 366 (cold rolled).
 - 2. Non-Structural Use: ASTM A 569 (hot rolled) or A 366 (cold rolled).
- E. Fasteners and Accessories: Provide anchor bolts, clip angles, hanger rods and other hardware, accessories and incidental materials required for complete installation of stairs and rails.
- F. Welding Materials: Conform to AWS code and AWS filler metal specifications for material being welded.

- G. Primer: Acrylic Latex rust-inhibitive primer containing less than 1.0 lb/gal volatile organic compounds (VOC), certified to be compatible with finish coats specified in Section 09900.
- H. Concrete Materials and Reinforcement: Comply with the applicable requirements of Division 3.

2.3 FABRICATION

- A. Use same material and finish as parts being joined, except use stainless steel between dissimilar metals and non-corrosive fasteners at exterior connections or joints.
- B. Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.
- C. Construct stairs and rails with all components necessary for support and anchorage, and to provide a complete installation.
- D. Shop welding and joining shall conform to AWS D1.1 and AWS D1.3 requirements.

2.4 STANDARD STAIR AND RAIL SYSTEM

- A. Stairs and Landing: Manufacturer's standard prefabricated, pre-assembled stair and landing system, consisting of hot rolled steel sheet treads, risers, and landings. Stringers shall be steel channel with side mounted prefabricated railings.
 - 1. Stringers: Minimum thickness or gauge as determined by structural design calculations, structural grade steel channel.
 - 2. Risers: Closed riser, minimum 14-gauge hot-rolled mild steel sheet, sloped maximum 1-1/2 inches and conforming to ADAAG nosing requirements.
 - 3. Treads: Manufactures standard concrete pan system (Field Poured). Tread pans shall be minimum of 14 gauge, or as determined by design calculations. Pan depth 1-1/2 inches. Welds shall be exposed and visible after installation for subsequent inspections.
 - 4. Refer to Division 3 for concrete and field finish of treads.
 - 5. Mid Landings: Minimum of 11 gauge hot-rolled mild steel sheets, formed for a minimum 3 inches concrete fill, with 12 gauge channel supports and bracing welded to perimeter frame at 12 inches o.c.
 - 6. Fasteners and Supports: Sized by manufacturer to meet the structural design criteria.
- B. Railing: Manufacturer's standard welded steel tube handrail complying with the following requirements:
 - 1. Rails: 1-1/2 inches diameter by minimum 13 gauge round steel tube, continuous multi strand type, equally spaced not more than 3-15/16 inches clear between strands, and with a minimum extension per code at top and bottom risers. Wrap rail continuously past space between fights to form guardrail as required by building code. Terminate rail ends with radiused returns, newel posts, or safety terminations approved by local code. Provide brackets as required to attain clear distance between rail and wall as shown on the drawings.
 - 2. Rail Posts: 1-1/2 inches square by 11-gauge tubing. Rail posts to fasten to side of plate stringers per manufactures shop drawings. Manufacture to pre-weld erection aid to rail post for proper height to aid stair erector. Erection aid (setting block) to be removed and weld ground smooth after installation.
 - 3. Fabrication:
 - a. Use preformed or prefabricated bends.
 - b. Butt weld tee and cross intersections in tubing; cope and weld intersections in pipe. Miter elbows.
 - c. Mechanically fasten internal sleeves and fittings.
 - d. Provide minimum 3/16-inch welded steel plate closures or hemispherical closure fittings on all exposed rail ends.

2.5 SHOP CLEANING AND FINISHING

- A. Rails and Stair Components: Completely remove oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter from surface of steel in accordance with SSPC-SP3.

- B. Shop Primer: Immediately after shop fabrication and cleaning, spray apply one coat of anti corrosive primer to a minimum dry film thickness as recommended by primer manufacture, but not less than 2.0 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates and adjacent construction have been properly constructed. Verify structural framing, enclosures, weld plates, blocking, and size and location of pockets.
- B. If unsatisfactory conditions are encountered, notify Architect in writing. Do not proceed until unsatisfactory conditions have been corrected.
- C. Notify Manufacturer of any detail, design or tolerance deviations as noted or drawn on stair shop drawing.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.3 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, non-shrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post installed anchors and bolts.

3.5 ADJUSTING AND CLEANING

- A. Touch-up field welds and abraded areas by application of same coating used for shop primer.
- B. After stairs are completely installed, clean surface of exposed rail and stairs with wet cloth or mop. Leave stair system ready for finish painting.

3.6 CONCRETE FILL TREATMENTS

- A. Concrete Placement: Place concrete in accordance with Section 03310. Provide steel trowel finish.

END OF SECTION

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Alternate submission requirements of work included in Alternates.
- B. Related Sections:
 - 1. Contract Between Owner and Contractor: Acceptance of Alternates in award of a Contract.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated and defined on the Bid Form for certain work that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates will be a part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- B. Execute accepted alternates under the same conditions as other work of the Contract.

1.4 SUBMISSION REQUIREMENTS

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted alternates will be identified in the Contract between Owner and Contractor.

1.5 SCHEDULE OF ALTERNATES AND DESCRIPTION OF WORK INCLUDED IN ALTERNATES.

- A. Schedule of Alternates, when applicable, and descriptions thereof are shown on the Bid Form.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

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END OF SECTION

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SECTION 01255 - REQUEST FOR INFORMATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requests for Information (RFI) procedures.

1.2 DEFINITIONS

- A. Requests for Information: A formal online process used during the construction phase to facilitate communication between the Contractor, the Owner Construction Manager (CM), and the Professional of Record (POR) with regard to requests for additional information and clarification of the intent of the Contract Documents (Drawings and Specifications).
- B. Professional of Record (POR): The Architect of Record (AOR) or the Civil Engineering Consultant (CEC).
- C. Architect of Record (AOR): The prime consultant in charge of overall design and coordination of the project. The AOR will be the administrator for all construction RFIs classified as "BLDG".
- D. Civil Engineering Consultant (CEC): The Registered Engineer in responsible charge of the civil design for the project. The CEC will be the administrator for sitework RFIs classified as "SITE".
- E. Owner's Construction Manager (CM): The Owner's building and sitework Construction Manager for the Project.

1.3 REQUEST FOR INFORMATION SUBMITTAL

- A. Submit requests for information for conditions requiring clarification of the Contract Documents on Owner's approved website platform. POR will not respond to requests for information unless this format is utilized and all appropriate information is provided. Faxed or e-mailed RFIs will not be reviewed.
- B. Submit in accordance with procedure as follows: (See Process Flow Chart at the end of this Section)
 - 1. Subcontractors, manufacturers, and suppliers shall submit request for additional information and clarification to Contractor.
 - 2. Contractor shall contact Owner's CM with requests for additional information or clarification. Owner's CM will not accept requests for information or clarification submitted directly from subcontractors, manufacturers, or suppliers.
 - 3. As Directed by the Owner's CM, the Owner's CM will provide response to Contractor or will direct Contractor to submit a formal Request for Information.
 - a. Submit a formal RFI only if authorized by the Owner's CM. Submittal to Construction RFI website signifies authorization has been given.
 - b. Generate Requests for Information by one source per project.
 - c. Submit one request for information per website entry.
 - 4. POR will review formal requests from Contractor and provide response within 3 working days.
 - 5. POR's response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Sum or Contract Time.
- C. Scheduling, Costing, and Owner Provided Equipment Coordination: Direct to the Owner's Construction Manager.

1.4 PENALTY FOR FAILURE TO FOLLOW PROCEDURE

- A. A \$250 administrative cost will be assessed to the Contractor for each Request for Information submitted which does not follow the procedure specified above.

1.5 REIMBURSEMENT FOR ARCHITECTURAL AND ENGINEERING FEES

- A. The Contractor shall be charged administrative costs and professional fees incurred by Owner for additional Architectural and Engineering services associated with the correction of completed Work which is not in accordance with the Contract Documents. Refer to Paragraph 8.7 of the Construction Contract between Owner and Contractor for provisions relating to correction of Work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01310 - CONSTRUCTION MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project Management and Coordination:
 - a. Definitions
 - b. Construction Manager
 - c. Project Coordination

B. Related Requirements:

1. Contract between Owner and Contractor: Owner's Construction Manager's rights and scope of authority.

1.2 DEFINITIONS

- A. Separate Contractor: A contractor (subcontractor, specialty contractor or vendor) hired separately by Owner and outside of General Contractor's Contract.
- B. Owner Construction Manager (CM): The Owner's representative in all matters relating to the Work of the Project. The person responsible for all approvals with the General Contractor. This person also coordinates with the Separate Contractors.

1.3 OWNER'S CONSTRUCTION MANAGER

- A. Owner will assign this project to a staff Owner's Construction Manager. The Owner's Construction Manager is the Owner's representative in all matters relating to the Work.
- B. Cooperate with the Owner's Construction Manager in all matters relating to the Work on this project.
- C. During construction, coordinate use of site and facilities through the Owner's Construction Manager.
- D. Comply with Owner's Construction Manager's procedures for project communications, reports and records, and coordination with drawings, and comply with recommendations and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Owner's Construction Manager for use of temporary utilities and construction facilities.

1.4 RESPONSIBILITIES OF GENERAL CONTRACTOR AND SEPARATE CONTRACTORS

- A. The General Contractor shall provide necessary forces and subcontractors to complete the Work of the Project as described in the Contract Document (Drawings, Specifications, Addenda, and other modifications to the Contract). He is responsible for the supervision, quality control and costs for his employees and subcontractors.
- B. The General Contractor and Separate Contractors will provide a Construction Schedule to the Owner's Construction Manager for review and approval. The Contractors shall immediately contact the Owner's Construction Manager if the Work does not progress as scheduled. It is imperative that the Contractors keep close communication with the Owner's Construction Manager regarding the progress of the Project.
- C. At the commencement of construction, the Owner's Construction Manager, facility General Manager, General Contractor, and Separate Contractors will review the Construction Schedule. The Construction Schedule is set up on a weekly basis and must be followed unless deviations are authorized by the Owner's Construction Manager. (Refer to Section 01500 for posting of schedule.)

- D. The General Contractor and Separate Contractors shall communicate at all times with the facility General Manager, and other Subcontractors to facilitate the construction and ensure it is completed within the approved time schedule.
- E. Upon completion of a portion of the Work (Item, Trade, etc.), that portion of the Work must be 100% complete prior to proceeding to the next phase or portion of Work.
- F. The General Contractor shall be responsible for the coordination of the Remodel work of all Separate Contractors with the Owner's Construction Manager and the facility General Manager.
- G. The Construction Manager will determine what work shall be done during normal operating hours.
- H. The General Contractor shall also be responsible for coordinating the location of storage trailers/containers for Contractor-supplied materials and equipment. (Refer to Section 01500). The General Contractor shall be responsible for permits required for temporary storage facilities (trailers/containers).
- I. The Owner will not be responsible for the loss of any tools or equipment. The Owner will also not be responsible for the cost of any rental tools. This is each Contractor's responsibility and should be included in his price proposal.
- J. Contractors shall comply with Owner's policy regarding gratuities. No Contractor may receive any gratuities from any company providing services or materials for any of Owner's Projects.
- K. The General Contractor shall be responsible for timely removal of the construction trailer as directed by the Owner's Construction Manager.
- L. The Owner may provide Facility Associates as required to assist the General Contractor and Separate Contractors in the remodeling. The Owner's associates shall not be allowed to operate power equipment, be used as carpenters, or perform work from scaffolds, ladders or hoists.
- M. The General Contractor and Separate Contractors are responsible for obtaining a final inspection from the appropriate Building Official or Authority Having Jurisdiction (AHJ). If a Certificate of Occupancy is required, obtain it from the proper authorities. A copy of all final inspection documentation or Certificates of Occupancy shall be included in the final Closeout Documents (Maintenance Book/Closeout Book).

1.5 PROJECT COORDINATION

- A. Coordinate scheduling, submittals, and work of the various Sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed at a later date and under separate contracts.
- B. Obtain necessary drawings, manufacturer's product data, and other necessary data to provide a complete and proper installation.
 - 1. Check field dimensions prior to installing equipment and furnishings. Verify necessary clearances and means of access from equipment storage to final position.
 - 2. Make shop drawings and manufacturer's rough-in requirements available to trades involved.
- C. Verify that utility requirements of operating equipment are compatible with building utilities. Coordinate work of various specification Sections for installation and final connection of equipment.
 - 1. Verify that mechanical, plumbing, and electrical rough-ins have been properly located.
- D. Coordinate space requirements and installation of mechanical and electrical Work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduits as closely as practicable. Make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

- E. In finished areas, conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean up of work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owners partial occupancy after possession.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

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END OF SECTION

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SECTION 01311 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Progress and quality control meetings.

1.2 PROJECT MEETINGS

- A. Conduct project meetings, as a part of the overall project coordination effort, to coordinate construction activities and Work.

1.3 ATTENDEES' AUTHORITY

- A. Persons designated by Contractor, subcontractors, and suppliers to attend project meetings: Possess authority to commit entities they represent to items agreed upon in project meetings.

1.4 PROGRESS AND QUALITY CONTROL MEETINGS

- A. Schedule and conduct progress meetings throughout the progress of the Work at intervals determined by the Owner's Construction Manager.
- B. Attendance Required: Owner's Construction Manager, Owner's Representative, Contractor Project Coordination Administrator, Contractor Quality Control Representative, and Contractor Project Field Superintendent.
- C. Minimum Agenda: Review items of significance that may affect project progress, including the following:
 - 1. Minutes of previous meetings.
 - 2. Work progress in relation to Contractor's construction schedule.
 - 3. Status of required submittals.
 - 4. Payment request status. Documentation of information for payment requests.
 - 5. Field observations, Requests for Information, discussions of problems, and agreement on solutions.
 - 6. Quality of materials and workmanship.
 - 7. Corrective measures to regain quality of materials and workmanship; status of products, assemblies, or systems requiring replacement.
 - 8. Status of change orders.
 - 9. Corrective measures to regain projected schedules.
 - 10. Planned progress for period prior to next scheduled Progress Meeting.
 - 11. Effect of proposed project changes (if any) on construction schedule and coordination.
 - 12. Temporary facilities and services.
 - 13. Jobsite housekeeping and cleanliness.
- D. Documentation: Record minutes of conference and distribute copies to Owner's Construction Manager, participants, and those affected by decisions made, 2 working days after conference date. Recording, producing, and distributing by Contractor.
- E. Construction Schedule Update: Revise construction schedule after each progress meeting where schedule revisions have been made or recognized. Issue updated schedule concurrently with report of meeting.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Progress Schedules and Reports
- B. Related Requirements:
 - 1. Contract Between Owner and Contractor. Requirements for construction schedules and reports.

1.2 CONSTRUCTION SCHEDULE

- A. Using the Milestone Completion Dates identified in the Contract; the Contractor shall develop the detailed CPM Construction Schedule with activity time duration in calendar days further describing his method for performing the Work.
 - 1. The Milestone Completion Dates identified in the Contract shall not be construed as an indication by the Owner as to means, methods, or techniques of construction to be employed by the Contractor.
 - 2. Critical path activities shall be indicated on the Contractor's detailed construction schedule.

1.3 CONSTRUCTION PROGRESS CHART

- A. Progress of the Project will be monitored using charts produced from the CPM Schedule. Requirements herein provide for planning and execution of the Work and are to assist the Owner's Construction Manager in evaluating progress of the Work economically and chronologically.
- B. The Contractor shall be familiar, in detail, with the Milestone Completion Dates identified in the Contract. By submitting his bid, the Contractor acknowledges that the Construction milestones are feasible, reasonable, and are a workable schedule for the Work.
- C. Delivery conditions and lead times for Owner Furnished Items are specified in the Delivery Schedules in Section 01600. Coordinate delivery of these items with progress of the Work.
- D. Prior to construction, the Contractor may request reasonable changes to the Construction Progress Schedule Chart, provided delivery dates specified in Section 01600 and the contract completion date are not changed. The Owner's Construction Manager will review requested changes. Upon approval by the Owner, Progress Schedule Chart shall become the "Approved Construction Progress Chart" by which the Contractor shall plan, organize, direct, coordinate, and execute the Work, and the basis of evaluating progress of the Work.
- E. If, in the opinion of the Owner's Construction Manager, any of the dates specified in Section 01600 are not completed by the Contractor on or before the stated time period and after 48 hours written notice to the Contractor, the Owner may proceed to carry out the work in accordance with the Contract.
- F. The Contractor shall perform work directed by the Owner's Construction Manager to meet the Owner's contract completion date and shall maintain the original management and supervision team to continue their office and job site duties on a full-time basis through final completion and/or any other time the Contractor has any work being performed on the project regardless of the date or condition of project completion.

1.4 SCHEDULE UPDATES

- A. The Contractor shall provide to the Owner's Construction Manager regular updated reports on the Construction Schedule as determined by the Owner's Construction Manager. The Contractor shall maintain a current weekly updated detailed construction schedule in the site construction field office.

1. Construction Schedule Updating: Progress information to be included in schedule updates includes actual start and finish dates, percentage complete, remaining duration or projected finish dates for all activities in progress during reporting period. Schedule updates may also include approved added activity descriptions.

1.5 RECOVERY PLAN

- A. Should the updated approved Construction Schedule show the Contractor to be behind schedule, the Contractor shall immediately devise a plan for recovery of lost time and submit it to the Owner's Construction Manager for approval. Once approved by the Owner's Construction Manager, the Contractor shall immediately put the recovery plan into action.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal procedures prior to and during construction.
- B. Related Sections:
 - 1. Section 01600 - Product Requirements: Requirements for product selection and product options.
 - 2. Section 01770 - Contract Closeout: Closeout submittals.

1.2 PROCESS AND RESPONSIBILITIES

- A. Contractor Responsibilities:
 - 1. Submit required submittals to Architect unless otherwise specified.
 - 2. Submit required submittals in hard copy or electronically by email. Electronic documents shall be in PDF format. Hard copy documents submitted to the Contractor by suppliers and subcontractors shall be scanned by the Contractor to PDF prior to electronic submittal.
 - 3. Comply with submittal requirements defined within individual Sections. Submittals procedures described herein shall apply unless otherwise stated in individual Sections.
 - 4. Package each submittal appropriately for transmittal and handling.
 - 5. Identify Project, Contractor, subcontractor or supplier, pertinent Drawing sheet and detail numbers, and Specification Section number, as applicable.
 - 6. Assemble, coordinate, and review submittals of subcontractors, suppliers, and manufacturers.
 - 7. Review submittal for verification of products required, field dimensions, adjacent construction, and coordination of information.
 - 8. Apply Contractor's Submittal Review stamp, signed or initialed and dated, certifying compliance with Contract Documents.
 - 9. Identify email transmittal of submittals in the subject line as follows:
 - a. DC #, City, State, Facility type RDC, GDC, etc.), submittal name (e.g. concrete mix design, sieve analysis, etc., including Section number).
 - 10. Forward executed copy of Submittal Review Form to supplier within 5 days after receipt of submittal with copies to Architect and the Owner's Construction Manager.
 - 11. Schedule submittals to expedite the Work. Coordinate submission of related items into single submittal, unless otherwise specified.
 - 12. Submit submittals items required within an individual Specification Section into a single submittal.
 - 13. Identify variations from Contract Documents and limitations of product and system which may be detrimental to successful performance of the completed Work.
 - 14. Provide space on submittal for Contractor, Architect, and Architect's Consultant review stamps.
 - 15. Allow 10 working days for review.
 - 16. Revise and resubmit submittals when required. Identify changes made since previous submittal.
 - 17. Notify Vendor or Subcontractor of approval by Authority Having Jurisdiction of Deferred Submittal package.
 - 18. Distribute copies of reviewed submittals to concerned parties and to Record Documents file. Instruct parties to promptly report inability to comply with provisions.
- B. Supplier Responsibilities - Owner Furnished Products:
 - 1. Subcontractors, vendors, and suppliers (including suppliers of Owner furnished products) shall forward copies of submittals to the Contractor.
 - 2. Prepare submittals in accordance with requirements in individual Specification Sections and Contractor responsibilities specified herein.
- C. Architect Responsibilities: Review submittals and take appropriate action as follows.
 - 1. Shop Drawings and Product Data: Architect will mark submittals to indicate appropriate action.

2. Return Architect reviewed Submittals to Contractor by email or mail carrier service providing delivery tracking.
3. Submittals for Information: Architect will not return submittals sent for information only.
4. Forward submittals to proper sub-consultant for review as necessary.

D. Unrequested Submittals: Submittals transmitted to Architect or Architect's Consultants that are not indicated or requested will not be reviewed. Architect will dispose of unrequested submittal items.

1.3 TRANSMITTAL

A. Transmit each submittal using a transmittal form. Submit to Architect.

1. Transmit submittals to be reviewed by Architect to:

DC REMODEL TEAM
Submittal Reviewer
BRR Architecture
8131 Metcalf Avenue, Suite 300
Overland Park, KS 66204

2. Transmit submittals to be reviewed by Structural Engineer of Record to:

Structural Consultant
Johnston Burkholder Associates
930 Central Street
Kansas City, MO 64105
(816) 421-4200
wmshopdrawings@jbaengr.com

3. Transmit 3 copies of fire protection submittals to the Owner's Fire Protection Consultant listed below within 21 days of prime contract award. Send one copy of the submittal transmittal to the Architect listed above.

Fire Protection Engineer of Record
Henderson Engineers, Inc.
8345 Lenexa Drive, Suite 400
Lenexa, Kansas 66214
fireSOR@hei-eng.com

4. Transmit sitework submittals directly to Civil Engineer of Record.

B. In addition to recipients stated above, transmit submittals to those parties as may be required in the individual specification section.

1.4 DEFERRED SUBMITTALS

A. Definition: Deferred Submittal are submittals required by the AHJ for code compliance but which, rather than being submitted at the time of permit application, have been allowed by the AHJ to be deferred until after Contract award to enable the successful Contractor, Subcontractor, or Supplier to submit the applicable submittals.

B. Submit the deferred submittals to the extent indicated on the Deferred Submittal Table located on the Drawing Cover Sheet.

C. Prepare submittals in accordance with requirements stated in the applicable individual Specifications Sections and the applicable requirements herein

1. Storage Rack System (Owner Vendor): Storage Rack System is not specified in an individual section. Requirements are as follows:
 - a. Coordinate with the Owner's Construction Manager to obtain copy of approved submittal package.
 - b. Shop Drawings:
 - 1) Floor plan showing locations and types of rack systems.
 - 2) Details of each type of rack construction showing configuration, dimensions and materials.

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- 3) Details of rack connection to building floor or structure.
- 4) Seismic bracing and connections (where required).
- c. Calculations: Structural calculations for rack connections to building floor or structure and seismic provisions.

D. Process:

1. Immediately after award of the Contract, the Contractor shall contact the AHJ to coordinate and determine the AHJ requirements for deferred submittals. Information obtained shall include such requirements as number of copies; extent of detail of information to be submitted; review, if required, by Professional of Record (Architect or Engineer); and other necessary process and procedural requirements.
2. The Contractor, or other entity, responsible for the submittal shall submit, track, and report submittal status to the Owner's Construction Manager through final approval and issue of permit.
3. Communicate with vendors, suppliers, and Subcontractors the AHJ requirements for deferred submittals. Receive, review, and stamp submittals in accordance with submittal requirements herein.
4. Transmit deferred submittals directly to AHJ unless otherwise requested by AHJ to obtain prior review and approval by Professional of Record.
5. Upon approval by AHJ, obtain permits and pay permit fees and other fees required by the AHJ.
6. Attach approved deferred submittals to the approved "Permit Set" documents at the project site.
7. Do not install deferred submittals until corresponding submittal documents have been approved by the AHJ.

1.5 SUBMITTAL REQUIREMENTS

A. Shop Drawings

1. Submit Drawings with graphic information at accurate scale. Show dimensions and note which dimensions are based on field measurement. Identify materials and products in Work shown. Indicate compliance with specified standards and special coordination requirements. Do not use reproductions of Contract Drawings as Shop Drawings.
2. Include on each Shop Drawing the drawing title, number, original issue date, and revision numbers and dates, in addition to other required identifying information.
3. Identify details by reference to sheet, detail, schedule, or room names shown on the Contract Drawings.
4. Identify numerical values in English units.
5. Size: Not less than 8-1/2 by 11 inches nor more than 30 by 42 inches.
6. Number of Copies Required: Submit one PDF file. Submit additional copies to AHJ for approval if required. Comply with requirements of AHJ with regard to signing and sealing of submittals by Registered Professional licensed in the State in which project is located.
 - a. One PDF copy will be returned to the Contractor through approved web platform.
 - b. Bar Joists and Joist Girders, and Steel Roof Deck: Submit Shop Drawings and bills of materials directly to Structural Engineer of Record via email.

B. Product Data

1. Manufacturer's standard schematic drawings and diagrams:
 - a. Clearly mark to identify pertinent products.
 - b. Show performance characteristics and capacities.
 - c. Show dimensions and clearances required.
 - d. Show wiring or piping diagrams and controls.
 - e. Modify drawings and diagrams to delete information not applicable to this work.
 - f. Supplement standard drawings and diagrams to provide complete information applicable to this work.
2. Mark each copy to identify applicable products, models, options, and other data. Supplement Product Data with material prepared for the Work to satisfy submittal requirements for which Product Data does not exist. Note that the material is developed specifically for this Contract.
3. Submit Product Data for each Section in one complete submittal. Include table of contents listing page and catalog item numbers for Product Data.
4. Indicate, by prominent contrasting color notation on each product being submitted, the Specifications Section and paragraph numbers to which it pertains.
5. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate information applicable to Work and clearly cross out other information not applicable to Work. Include the following information:

- a. Manufacturer's printed recommendations or instructions.
 - b. Compliance with referenced standards.
 - c. Application of testing agency labels and seals.
 - d. Notation of dimensions verified by field measurement.
 - e. Notation of coordination requirements.
6. Product Data For Information: Written information not requiring action by Owner's Construction Manager or Architect; for verification of compliance with requirement. Submittal not complying with requirements will be rejected.
- C. Engineering Calculations
1. Submit calculations signed and sealed by a Registered Professional Engineer licensed in the State where project is located. Comply with requirements of Authority Having Jurisdiction with regard to signing and sealing of submittals.
- D. Certifications
1. Certify manufacturer or installer's qualifications, compliance with tests or specified criteria, or other factors as required in individual Specification Sections.
 2. Submit supporting reference data, affidavits, and certifications as required.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01351 – REGULATORY COMPLIANCE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contractor’s regulatory compliance requirements and responsibilities.
 - 2. Owner’s compliance performance standards and expectations.

- B. Related Requirements and Sections:
 - 1. Contract Between Owner and Contractor (Contract).
 - 2. Owner’s Compliance Performance Standards (CPS) for Major projects as specified in the contract addendum.
 - 3. Owner’s Environmental, Health and Safety Manual (EHS) for minor projects as specified in the contract addendum.
 - 4. Section 01500 - Temporary Facilities and Controls.
 - 5. Section 01550 - Tension Pole Dust Barrier Systems.
 - 6. Section 01740 - Cleaning and Trash Disposal.
 - 7. Section 02023 - Selective Site Demolition.
 - 8. Section 02370 - Erosion and Sedimentation Control (Including SWPPP).

1.2 PROCESSES, PROCEDURES AND RESPONSIBILITIES

- A. Comply with all compliance obligations, federal, state, and local laws described in the Contract Documents including: Contract, Specifications, Drawings, applicable Owner’s Compliance Performance Standards (CPS) or Environmental, Health and Safety (EHS) manuals.

- B. Do not use Owner’s CPS or EHS in place of or as a substitute for developing and implementing the Contractor’s own compliance programs.

- C. Create and maintain a hard-copy site-specific “Compliance Binder,” including all associated documents in accordance with the requirements in the Owner’s CPS manual.

- D. Do not create conditions that would cause harm to Owner’s associates or members or prevent Owner’s compliance with applicable laws.

- E. Follow and uphold the applicable Owner’s compliance standards including responsibilities, processes and procedures, compliance acknowledgements, training, documentation, forms, tracking and reporting.

- F. Comply with all requirements set within the Contract Documents, including but not limited to: references and definitions, document management, safety requirements and safety plans, hazard safeguards, dust walls and barricades, hazardous materials and safety data sheets, respirable crystalline silica, hot work, fire watch, electrical work and supervision, lockout tagout, fuel storage, crane operations, confined spaces, edge protection netting, emergency exits, toxic and hazardous substances, asbestos, mold, site security and protection, labor work verification programs, badging and access control, waste management and disposal, hazardous waste management, waste container access restrictions, spills, construction stormwater permitting, sanitary waste water and sewage management.

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SECTION 01452 - CONTRACTOR'S QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for Contractor quality assurance and quality control.

B. Related Requirements:

1. Contract between Owner and Contractor: Inspections, testing, and approvals required by public authorities.
2. Section 01770 - Contract Closeout: Project Record Documents.
3. Appendix B - Testing, Inspection, and Observation by Owner.
 - a. Quality Requirements of Owner's Construction Testing laboratory (CTL) and services.
 - b. Architect-Engineer Site Observation: Site observation by Owner's Architect and Engineer Consultants.
 - c. Civil Engineering Consultant Site Observation: Site observation by Owner's Civil Engineering Consultant.

C. Contractor testing and inspection are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Contractor testing and inspection includes testing or inspection to be performed by and under the responsibility of the General Contractor as well as that required by the manufacturer, manufacturer's representative, product supplier, or other party under the responsibility of the Contractor.
2. Requirements in this section are independent of testing and inspection specified for the Owner's Construction Testing Laboratory (CTL) specified in Appendix B. Testing and inspection by the CTL will be paid for by the Owner at no cost to the Contractor.
3. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
4. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner's CTL, Owner's Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Testing: Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.

B. Inspection: Evaluation of systems primarily requiring observation and engineering judgement.

C. Quality Assurance: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will substantially comply with construction documents.

D. Quality Control: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction substantially comply with construction documents.

E. Quality assurance and quality control may be performed by either the Contractor or the Construction Testing Laboratory employed by the Owner.

F. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify or demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination,

testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

- G. Architect of Record (AOR): The prime consultant in charge of overall design and coordination of the building.
- H. Engineer of Record (EOR): The Registered Engineer in responsible charge of engineering design for the project.
- I. Structural Engineer of Record (SER): The Registered Engineer in responsible charge of the structural design for the project.
- J. Civil Engineering Consultant (CEC): The Registered Engineer in responsible charge of the civil design for the project.
- K. Architect - Engineer (A/E): A collective term to include the AOR, CEC, SER, and the Mechanical, Electrical, and Fire Protection EOR.
- L. Construction Testing Laboratory (CTL): The independent testing and inspection agency employed by the Owner.
- M. Test and Balance Agent (TBA): The HVAC testing and balancing agency employed by the Owner.
- N. Special Inspector (SI): The Special Inspector under the direct supervision of a registered civil/structural engineer (unless otherwise specified) regularly engaged in inspection, and experienced with the type of work requiring related testing and inspection. The categories of special inspector are specified in Appendix B:
- O. Building Official: The Officer or his duly authorized representative charged with the administration and enforcement of the local building code.
- P. Deviation: A deviation is any item or component of work that does not substantially conform to the requirements of the construction documents and which has not been corrected by the end of business on the day it is identified.

1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect/Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. Refer uncertainties to Architect/Engineer for a decision before proceeding.

1.4 SUBMITTALS

- A. Submit Test and Inspection Reports within three working days of T&I occurrence.
- B. Submit required reports and other items to the following:
 - 1. AOR: (Construction Administration Leader).
 - a. Site work T&I.
 - b. Bldg T&I. AOR will transmit copy of Bldg T&I to SER.
 - c. Report of non-conforming work.
 - 2. CEC: Site work T&I only
 - 3. Contractor
 - 4. Building Official: Quantities as required by Jurisdiction.

1.5 REPORTS

- A. Submit reports as required herein and conduct and interpret tests and inspections.
- B. Testing and Inspection Report: Submit test and inspection reports including the following information:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Distribution Center number.
 - 4. Firm name and address.
 - 5. Name and signature of tester or inspector.
 - 6. Name and seal of registered engineer in responsible charge (as applicable).
 - 7. Date and time of sampling.
 - 8. Date of test or inspection.
 - 9. Identification of product and specification section.
 - 10. Location in project, including elevations, grid location and detail.
 - 11. Type of test or inspections.
 - 12. Results of tests or inspections and interpretation of same.
 - 13. Observations regarding compliance with Contract Documents or deviations therefrom.
- C. Submit a separate final signed report stating whether the work requiring inspection is, to the best of the inspector's knowledge, in conformance with the approved plans, specifications, and the applicable workmanship provisions of the building code.
- D. Reports shall be made on 8-1/2 by 11 white paper, suitable for photocopying and binding in booklet form. Sheets shall have the CTL letterhead (including phone number and address). Larger sheets shall be folded and bound into the booklet.
- E. Tests and inspections reports indicating non-conformance (deviations) to the Contract Documents shall be brought to the attention of the A/E within 24 hours upon discovery.
- F. Contractor shall send an RFI to the A/E on the same day of non-conformance (deviation) notification.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

- A. Quality control shall be the responsibility of the Contractor.
- B. The Owner will perform testing and inspection (T & I) but only as a means of verification to the Owner of Contractor quality control performance. Owner T & I shall not be considered Quality Control or Quality Assurance as defined herein. Owner T & I and Contractor obligations with respect to Quality Control shall be pursuant to related provisions of the Contract between Owner and Contractor.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- C. T & I by the Owner will be conducted by the Owner's Construction Testing Laboratory at no cost to the Contractor in accordance with Appendix B, except that costs for failing tests will be deducted from the sum due to the Contractor.
- D. Owner T & I results and reports will be available as information to Contractor.

- E. Owner's T & I shall not be relied on by the Contractor as an indication of conformance or nonconformance of work nor shall the Contractor be dependent on the Owner's CTL test results for verification of satisfactory work in place.
- F. Work found by the Owner's CTL to be defective or in non-compliance with Contract Documents shall be corrected based on the CTL T&I results except when proven otherwise by subsequent CTL or Contractor conducted tests.
- G. In-place work will be subject to testing and inspection by the Owner's CTL at any time during the progress of the work.
- H. Test reports conducted by and at the discretion of the Contractor shall be provided to the Owner upon request when reason exists to suspect non-compliance or when used for comparison to CTL conducted tests.
- I. Any testing agency, if employed by the Contractor for purposes of Contractor Quality Control, shall not be the same entity engaged by the Owner.
- J. Contractor shall pay for:
 - 1. Tests and inspections at the source or prior to incorporation into the Work of materials, products, or equipment to certify compliance with Contract Documents.
 - 2. Tests, samples, inspection, or engineering services the Contractor determines appropriate for performance of Work or for Contractor's convenience.
 - 3. Tests and inspections when initial tests or inspections indicate Work does not comply with Contract Documents.
 - 4. Tests and inspections required or conducted by public authorities as part of permits or inspection fees.
 - 5. Other tests and inspections indicated to be "by Contractor."
- K. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and to provide storage and curing of test samples. Provide lift equipment as required for inspection personnel of the Owner or the Owners's representatives.
- L. Provide 14 days written notice to A/E prior to expected time for operations requiring observation, inspecting, and testing. If work to be observed is covered prior to notification, uncover work as required.
- M. Notify in writing the Owner's Construction Manager three working days prior to expected time for operations requiring inspecting and testing services.
- N. Repair and protect the work regardless of assignment of responsibility for inspection, testing, or similar services.
 - 1. Protect work exposed by or for quality assurance and quality control service activities.
 - 2. Upon completion of inspection, testing, sample-taking, and similar services, restore constructed areas to conform to Contract Documents.
- O. Costs, including without limitation additional professional fees and expenses, of any required redesign or re-engineering required by non-conforming tests and inspections will be deducted from the sum due the Contractor.
- P. Provide a Letter of Conformance at the completion of the Project to the Owner's Construction Manager, with copy to the AOR, stipulating that the Project has been built per the Contract Documents. An example is attached at the end of this Section.
- Q. Maintain a copy of Contract Drawings and Specifications with all Addenda and Change Orders. Use the Contract Documents supplemented by the approved shop drawings and applicable material and workmanship provisions of the Code for testing and inspection of the work.
- R. Provide qualified personnel at site to comply with schedule and submit reports for each test and inspection as defined in Part 3 of this Section.
- S. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- T. Ascertain compliance of materials and mixes with requirements of Contract Documents.

- U. Perform testing and inspection in a timely manner to avoid delay of work.
- V. Notify Owner's Construction Manager and CEC or AOR, as applicable of observed non-conformance of Work or Products. If observed deviations from the Contract Drawings, Specifications, or building code will be probable cause of subsequent rejection of work or material, notify the Owner's Construction Manager and, CEC or AOR sufficiently in advance for determination to continue operations or take corrective measures before continuing.
- W. The Owner's Construction Manager in conjunction with the CTL and/or SI will determine when to involve the AOR or EOR for remedial action.
- X. If additional A/E site or FPT visits are required beyond those described in Section 01454 as determined by the Owner to determine correction to non-conforming work, the Contractor shall reimburse the Owner for each additional visit to cover A/E expenses. Additional A/E site observations or FPTs will be performed as required until all deviations have been corrected by the Contractor and closed by the A/E consultant.
- Y. Cooperate with CTL/SI personnel and provide access to the Work and to Contractor's facilities.
- Z. Submit test and inspection reports to the A/E consultant and other designated persons as specified in individual sections. Submit test and inspection reports to the Building Official as required.
- AA. Testing and inspection by the Building Official does not preclude the normal field involvement and site observations by the A/E consultant, nor shall it relieve the Contractor of any responsibility to complete the work in accordance with the approved drawings and specifications.
- BB. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

3.2 PRODUCTION TESTING

- A. General Requirements:
 - 1. Testing shall be conducted as specified in the individual specification sections.
 - 2. If inspection of fabricators work is required, the Owner's representative may require testing and inspection of the work at the plant, before shipment. Owner, Architect, and Structural Engineer of Record (SER) reserve the right to reject material not complying with the Contract Documents.
 - 3. Testing and inspection shall be performed in accordance with the industry standard used as the reference for the specific material or procedure unless other criteria are specified. In the absence of a referenced standard, tests shall be accomplished in accordance with generally accepted industry standards.
 - 4. Work shall be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work.

END OF SECTION

[Example Conformance Letter from Contractor. Text in parentheses are to be edited for each individual project]

[Date]

[Mr. Construction Manager]
Wal-Mart Construction
2608 SE J ST
Bentonville, Arkansas 72716

[Re: Distribution Center (Facility #xxx) – City, State]

[Dear Construction Manager:]

The purpose of this letter is to state to Wal-Mart Stores, Inc. that, to the best of our knowledge, the construction on the above referenced project has been completed in substantial conformance with the approved Contract Documents.

We performed construction testing, observation, and testing as required by the Contract Document. To our knowledge, no outstanding items exist except as may be otherwise entered and shown on the Wal-Mart Observation Log.

Sincerely,

[GENERAL CONTRACTOR]
[Include signature and date of signature]

cc:
File
[ARCHITECT OF RECORD]
[ENGINEER OF RECORD]

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SECTION 01454 - ARCHITECT-ENGINEER QUALITY ASSURANCE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quality assurance site observation of construction by Architect and Engineers of Record.
- B. Related Requirements:
 - 1. General Conditions: Inspections, testing, and approvals required by public authorities.
 - 2. Section 01452 – Contractor Quality Control: Administrative and procedural requirements for Contractor quality assurance and quality control.
 - 3. Appendix B – Testing, Inspection and Observation by Owner
 - a. Site observation by Architect-Engineer.
 - b. Civil Engineering Consultant Site Observation: Site observation by Owner’s Civil Engineering Consultant.
 - c. Construction Laboratory Testing Services: Testing and Inspection by Owner’s Construction Testing Laboratory (CTL) and services.

1.2 SELECTION AND PAYMENT

- A. Employment and payment for services of Architects and Engineers to perform specified site observation of construction will be by Owner.

1.3 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall:
 - 1. Cooperate with A/E personnel and provide access to the Work and to Contractor’s facilities.
 - 2. Provide incidental labor and facilities to provide access to Work to facilitate observation and testing. Provide lift equipment as required for A/E personnel.
 - 3. Provide A/E 14 day’s written notice prior to expected time for activities requiring observation services.
 - 4. Maintain a copy of Contract Drawings and Specifications with all Addenda and Change Orders supplemented by the approved shop drawings and applicable material and workmanship provisions of the Code for use by the A/E.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SITE OBSERVATION

- A. Site observation by Owner’s Architects and Engineers is specified in Appendix B.

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END OF SECTION

01454-2

SECTION 01457 - TESTING AND INSPECTION BY OWNER

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for Owner provided testing and inspection services.

B. Related Requirements:

1. Contract Between Owner and Contractor: Inspections, testing, and approvals required by public authorities. Contractor obligations to perform work in accordance with Contract Documents.
2. Section 01452 – Contractor Quality Control: Administrative and procedural requirements for Contractor quality assurance and quality control.
3. Section 01770 - Contract Closeout: Project Record Documents.
4. Appendix B - Testing, Inspection, and Observation by Owner:
 - a. Architect-Engineer Site Observation: Site observation by Owner's Architect and Engineer Consultants.
 - b. Civil Engineering Consultant Site Observation: Site observation by Owner's Civil Engineering Consultant.
 - c. Owner furnished Construction Laboratory (CTL) tests and inspections.
5. Section 13900 – Fire Suppression – Fire Sprinkler Site Observation and Acceptance Test (FPAT)

- C. General requirements for testing and inspection to be performed by the Contractor is specified in Section 01452.

1.2 OWNER RESPONSIBILITIES

- A. Employment and payment for services of a Construction Testing Laboratory (CTL) and/or Special Inspector (SI) to perform specified testing and inspecting will be by the Owner under separate contract except for specified testing required to be selected and paid for by the Contractor as may be required by individual specification sections.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with CTL/SI personnel and provide access to the Work and to manufacturer's facilities.
- B. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and to provide storage and curing of test samples. Provide lift equipment as required for inspection personnel of the Owner or the Owner's representatives.
- C. Provide CTL 24 hour notice prior to expected time for operations requiring inspecting and testing services.
- D. Owner to provide the CTL/SI with access to approved web platform.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

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END OF SECTION

01457-2

SECTION 01500 -TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, water, and sanitary facilities.
 - 2. Temporary Controls: Barriers, enclosures and fencing, signage protection of the Work, and water control.
 - 3. Construction Facilities: All-weather access roads, parking, progress cleaning, temporary buildings, and staging areas.
- B. Related Requirements:
 - 1. Section 01351 – Regulatory Compliance:
 - a. Non-hazardous waste storage fencing.
 - b. Work practice control methods for airborne respirable dust.

1.2 REFERENCES

- A. Occupational Safety and Health Administration (OSHA)
 - 1. OSHA 1926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Provide protective fencing, and safety signage.
- B. Provide enclosures for dust emitting interior work as specified herein and in Section 01550.
- C. Protect properties and water resources from contaminant damage until construction activities are complete.
- D. Do not use methods that would cause flooding, ponding, or other damage to Owner's property or property of others.

1.4 TEMPORARY ELECTRICITY

- A. Connect to existing power service. Owner will pay cost of electricity used. Power consumption shall not disrupt Owner's need for continuous service. Exercise measures to conserve energy.
- B. Coordinate location and method of connection to existing electrical service with Owner's Construction Manager. Do not connect to electrical panels serving rack houses.
- C. Provide adequate distribution equipment, wiring, and outlets to provide single-phase branch circuits for power and lighting. Provide temporary feeders to limit voltage loss to 5% overall from local utility power lines to provide electric requirements for project during construction.

1.5 TEMPORARY LIGHTING

- A. Provide and maintain lighting for construction operations. Provide minimum of 20 footcandles illumination for work areas.
- B. Permanent building lighting may be utilized during construction.

1.6 TEMPORARY HEAT

- A. Provide and pay for heat devices and heat as required to maintain specified conditions for construction operations.

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- B. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
 - C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- 1.7 TEMPORARY VENTILATION
- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- 1.8 TELEPHONE SERVICE
- A. Provide, maintain and pay for telephone service to field office.
- 1.9 TEMPORARY WATER SERVICE
- A. Connect to existing water source. Owner will pay cost of water used. Exercise measures to conserve water.
- 1.10 TEMPORARY SANITARY FACILITIES
- A. Provide and maintain required chemical toilet facilities.
 - B. Locate as directed by Owner's Construction Manager. Maintain facilities clean and serviced as necessary and in compliance with local health code requirements.
 - C. Existing facilities shall not be used by construction personnel.
- 1.11 TEMPORARY STORAGE CONTAINERS
- A. General Requirements:
 - 1. If required by Authority Having Jurisdiction, obtain all permits necessary for usage and placement of temporary storage container.
 - 2. Coordinate with Facility Manager to locate temporary storage container as approved by Authority Having Jurisdiction, when applicable.
- 1.12 BARRIERS AND CONSTRUCTION TRAFFIC SAFETY
- A. Protect non-owned vehicular traffic, stored materials, site and structures from damage.
 - B. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations.
 - C. Provide barricades and covered walkways required by governing authorities for public rights-of-way, to allow for Owner's use of site, and for public access to existing building.
 - 1. Erect barricades using 1/2" plywood on 2x4 framing. Supports shall be as required to uphold barricade. Verify requirements with Owner's Construction Manager.
 - 2. Construct 8'-0" high unless otherwise directed by owner.
 - D. When operating any motorized construction equipment in areas where Associates are present, provide a spotter (or signal person) whose sole job responsibility shall be to ensure safe operation, including directing traffic and keeping area of traffic clear of people.

1.13 TEMPORARY FENCING FOR CONSTRUCTION/DEMOLITION WASTE CONTAINERS

A. General:

1. Provide commercial grade temporary chain link fencing around general non-hazardous waste storage and sorting areas as specified in Section 01351.
2. Fencing shall be 8 feet high.
3. Maintain access to fire hydrants and hose connections, emergency vehicles, and other site specific conditions as required by Authority Having Jurisdiction.
4. Obtain permits required by AHJ for usage and placement of temporary chain link fencing.

B. Materials:

1. Posts: Galvanized steel pipe. Posts shall be suitable for setting in concrete footings or driving into ground as required by local conditions.
2. Fabric: Commercial-grade 2"-mesh chain-link fencing with full fence screening. Screening must be woven plastic cloth or plastic screening slats. No substitutions are allowed for fencing or screening material.
3. Gates: Provide personnel and vehicle gates of the quantity and size required for functional access to waste container storage area.
 - a. Fabricate gates and screening of same material as used for fencing.
 - b. Equip with locks.

C. Installation: Comply with manufacturer's recommendations.

1. Post and Fabric: Set posts in concrete footings, drive posts in ground, or set in holes and backfill to accommodate local conditions. Stretch fabric taut and attach to posts.
2. Gates: Install gates with required hardware.

D. Removal: After use of fenced areas and waste/recycling containers by Owner as specified in Section 01351, remove fencing and patch paving. Refer to Section 01731 for general patching requirements.

1.14 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

C. The Contractor shall at all times protect all activities of his construction, excavations, fill areas, embankments, trenches structures or building from damage from rainwater, spring water, ground water, backing up of drains, sewers and all other water encountered during his operations. He shall provide all pumps, equipment and enclosures necessary to provide adequate protection.

1.15 EXTERIOR ENCLOSURES

A. Provide temporary weather-tight closure of exterior openings to provide acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification Sections, and to prevent entry of unauthorized persons.

B. Provide access doors with locks.

1.16 INTERIOR ENCLOSURES

A. As shown on Drawings, provide sealed temporary partitions as specified herein and in Section 01550 to separate construction work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

B. Temporary Stud Framed Barrier / Dust Partitions: Installation and removal of temporary dust partitions shall be scheduled with a minimum of 3 days prior notification to Owner's Construction Manager and/or Facility Manager. Maintain temporary dust partitions to seal openings to Owner-occupied areas with closed joints and sealed edges at intersections with existing surfaces. These shall be scheduled, installed, and removed as required and directed

by the Owner's Construction Manager and may not be indicated on the Drawings. Install partitions prior to demolition of existing walls and maintain in dust tight condition until the completion of the new construction. It is the Contractor's responsibility to prohibit dust and debris from entering any Owner-occupied areas and to obtain approval from AHJ for materials/construction configuration and phasing of temporary enclosures.

1. Dust Wall Partitions:
 - a. Framing: (same as Type A below).
 - b. Covering: 6 mil. clear poly sheeting (if allowed by the Authority Having Jurisdiction); otherwise use Griffolyn type 55 ASFR, anti-static, fire retardant sheeting. Overlap sheeting at joints a minimum 2'-0" and continuously tape joints. Attach sheeting from ceiling to finish floor for dustproof condition. If attachment to ceiling is impossible, light framing shall be installed with sheeting attached all around to prohibit dust penetration.
 - c. Plywood (where required): Install 1/2" C-D plywood over 6 mil poly. Install 4'x8' sheets horizontally from finish floor to bottom of roof deck. Insure that blocking is provided behind each joint. Provide sealant at bottom of plywood at finish floor and continuous sealant against plate on other side.
2. Type A Partition / Dust Drape (no ceiling present):
 - a. Framing: Light gauge metal framing (refer Section 05400) or framing material approved by Authorities Having Jurisdiction (AHJ). Provide continuous 2x4 top and bottom plates and continuous bridging and bracing. Continue top plate to bottom side of roof deck.
 - 1) Walls up to 14'-0" may use 3-5/8" - 22 gauge metal studs at 24" o.c. or 2x4's at 16" o.c.
 - 2) Walls higher than 14'-0" may use 6" - 20 gauge metal studs at 24" o.c. or 2x6's at 16" o.c.
 - b. Covering: Install continuous 6 mil clear poly sheets (if allowed by the Authority Having Jurisdiction); otherwise use Griffolyn type 55 ASFR, anti-static, fire retardant sheeting. Install from finish floor to roof deck. Tape all joints. Install 1/2" C-D plywood over 6 mil poly. Install 4'x8' sheets horizontally from finish floor to bottom of roof deck. Insure that blocking is provided behind each joint. Provide sealant at bottom of plywood at finish floor and continuous sealant against plate on other side.
3. Type B Partition / Dust Drape (ceiling grid to remain in place):
 - a. Framing: (same as Type A above).
 - b. Covering: Install continuous 6 mil clear poly sheets (if allowed by the Authority Having Jurisdiction); otherwise use Griffolyn type 55 ASFR, anti-static, fire retardant sheeting. Install from finish floor to roof deck. Tape all joints. Install 1/2" C-D plywood over 6 mil poly. Install 4'x8' sheets horizontally to bottom of finish ceiling. Extend 6 mil poly to bottom of roof deck. Insure that blocking is provided behind each joint. Provide sealant at bottom of plywood at finish floor and continuous sealant against plate on other side.
4. Type D Security Partitions (exterior):
 - a. Framing: (same as Type A above).
 - b. Covering: At interior face of partition, install continuous 6 mil clear poly sheets (if allowed by the Authority Having Jurisdiction); otherwise use Griffolyn type 55 ASFR, anti-static, fire retardant sheeting. Install from finish floor to roof deck. Tape all joints. Install 1/2" C-D plywood over 6 mil poly. Install 4'x8' sheets horizontally to bottom of roof deck. Insure that blocking is provided behind each joint. At exterior face of partition, install 30 gauge, 24" wide corrugated metal panels as shown on the Drawings. Fill wall cavities with R-13 batt insulation. Provide sealant at bottom of plywood at finish floor and continuous sealant against plate on other side.
5. Doors:
 - a. Single acting doors, opening out, with sturdy closer, closing against gasketed stops on frame to reduce passage of dust.
6. Sealing:
 - a. Seal perimeter of partitions and doors to prevent passage of dust. At Type A and B partitions, tape fastener depressions, joints between panels and joints between panels and floors, ceiling and columns with 2 in. wide pressure sensitive tape.
7. Mats:
 - a. Provide mats at doors to reduce tracking of dust. Replace or clean daily.

1.17 FIELD OFFICES AND SHEDS

- A. Contractor's Office: (Not required for projects with a duration of less than 4 weeks, or as stated otherwise in Bid documents.)
 - 1. Size as required for Contractor's use and to provide space for project meetings.
 - 2. Adequate electrical power, lighting, heating, and cooling to maintain human comfort.
 - 3. Office space with desk and chair, layout table, plan rack, and facilities for storage of Project Record Documents.
 - 4. Furnishings in meeting area:
 - a. Conference table and chairs for at least eight persons.
 - b. Racks and files for Project Record Documents in, or adjacent to, the meeting area.
 - c. Other furnishings: Contractor's option.
 - 5. Contractor's office and sheds not to be used as living accommodations.
- B. Storage Sheds: Structurally sound, weathertight, on proper foundations, with floors raised above ground.
- C. Locate office and sheds minimum 30 feet from structures.

1.18 CONSTRUCTION AIDS

- A. Provide construction aids required to facilitate execution of Work, including stairs, ladders, ramps, staging, platforms, railings, cranes, scaffolds, hoists, chutes, runways, and other required facilities and equipment.
- B. Such apparatus, equipment and construction shall meet requirements of applicable OSHA (Federal), State and Local Safety and Labor Laws.
- C. Facility employees shall not be allowed access to scaffolds, ladders, and hoists.
- D. Coordinate crane service required for erection of structural steel, installation of HVAC Rooftop Units, and other crane services as required to accommodate the Owner's needs.

1.19 PROTECTION OF EXISTING WORK

- A. The existing building shall be protected from moisture, dust and debris. Install dust partitions or drapes as shown or as required to keep dust and moisture from the building premises.
- B. Provide suitable temporary watertight coverings over openings as required to protect interior work from inclement weather and related/adjacent construction areas.
- C. Maintain benchmarks, monuments and other reference point. If disturbed or destroyed, replace as directed.
- D. Protect existing adjacent streets, sidewalks, curbs, buildings and property, including trees, lawns and plants.

1.20 PROTECTION OF INSTALLED WORK

- A. Protect installed Work; provide special protection where specified in individual specification Sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Minimize traffic and storage on roofed surfaces. If traffic or storage is necessary, obtain recommendations for protection from roofing material manufacturer.

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- F. Do not operate cranes or other heavy equipment on concrete floor slabs if damage could result from such operations.
- G. Prohibit traffic from landscaped areas.

1.21 SECURITY

- A. Maintain the integrity of the existing building security and security systems at all times. Provide security and facilities to protect Work and Owner's operations from unauthorized entry, vandalism, and theft.
- B. Obtain permission and coordinate with Owner's security program through the Owner's Construction Manager at least 12 hours prior to the modification of any existing security system.
- C. Provide continuous security at openings cut into existing exterior walls and roofs.

1.22 ACCESS ROADS AND PARKING

- A. Construct and maintain temporary all weather roads accessing public thoroughfares to serve building pad and construction staging area.
- B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide temporary parking areas to accommodate construction personnel.

1.23 NOISE CONTROL

- A. Demolition and other Work that disturbs surrounding the Facility areas shall only be allowed in the following categories and time restrictions:
 - 1. Low Level Noise: Assembling trades such as electricians, ceiling installers, painters, tapers, etc.. Excludes all hammering and impact drilling. Low-level noise operations are allowed during Facility operational hours.
 - 2. Moderate Level Noise: Trades include gypsum board installers, stud partition installers, duct installers, etc. Includes occasional and intermittent hammering, screw drilling, etc.. Excludes impact drilling and concrete sawing. Moderate level noise operations may be allowed during Facility operational hours upon approval of the Owner's Construction Manager or Store Manager.
 - 3. High Level Noise: Constant loud and high pitched noise produced by impact drilling, concrete saw cutting, hammering of ductwork, and all demolition work. High-level noise operations shall be restricted to the Facility off-shift (evening) hours and as coordinated with Facility Operations.

1.24 PROGRESS CLEANING

- A. Refer to requirements specified in Section 01740.

1.25 SIGNAGE

- A. Temporary Construction Signage: Provide temporary signage for identification as required due to obscurity caused by construction. Provide signage for traffic control and safety information. Provide temporary pavement striping for traffic control and pedestrian safety. Provide temporary handicap parking spaces if existing spaces are at a non-accessible location to the building entrance.

1.26 INFORMATION/SAFETY BOARD

- A. Provide 4'x8'x3/4" C/D exterior glue plywood to be attached on the existing exterior wall at a location designated by the Owner's Construction Manager.

- B. Information/Safety Board shall be used to communicate safety, state & federal, hiring, OSHA and EPA requirements, bulletins and other information required for the construction of this Project.
- C. The board shall contain but not be limited to the following:
 1. OSHA Safety Requirements
 2. Federal and State Hiring Regulations
 3. Pertinent State, Local, and Federal Employment Regulations
 4. Building Permits
 5. Emergency telephone numbers
 6. Job Site Safety Meeting notifications
 7. EPA Permits or Notification regarding Asbestos or other Toxic or Hazardous Materials
 8. Other information required to comply with applicable OSHA, EPA and Federal safety laws
- D. Protect posted information with either plastic sleeves stapled to the board or 6 mil clear plastic sheathing over entire board providing access for posting of additional information.

1.27 POSTED CONSTRUCTION SCHEDULE

- A. Provide names/telephone numbers of the Owner's Construction Manager, General Contractor Project Manager, Superintendent and Phase I Supervisor. Maintain most recent and updated version of schedule.

1.28 STORAGE OF CONSTRUCTION MATERIALS AND EQUIPMENT

- A. The Work area may be used to store materials and equipment as approved by the Owner's Construction Manager. Provide storage trailers as required for storage of other materials. The Contractor shall not use Facility trailers or storage warehouses for materials/equipment storage.
- B. Storage of flammable/volatile liquid and paint materials within building is prohibited. Remove flammable materials, volatile liquids and paint daily from Facility.
- C. The Contractor may not store materials on site except for what is in use for the current work.
- D. Cover and protect material in transit.
- E. Stored materials shall be available for inspection by Owner at all times.
- F. The Owner is NOT responsible for the loss of any construction materials or the Contractors' loss of equipment or tools.

1.29 TEMPORARY FIRE PROTECTION

- A. Contractors and sub-contractors and their agents and employees shall comply with local fire protection codes and OSHA Regulations.
 1. Provide a minimum of one U.L. listed 2A:20BC dry chemical fire extinguisher, or one standard U.L. listed 2-1/2 ga. Water (E-10) and one U.L. listed 10BC carbon dioxide fire extinguisher mounted together, in each of the following areas:
 - a. Each 3000 sq. ft. of work area or fraction thereof with minimum of two extinguishers.
 2. Contractor's superintendent, or other assistant superintendents, shall be appointed as project fire warden for entire construction period.
 3. Train workmen in proper use of each type fire extinguisher.
 4. Post telephone number of fire department, specific information on location of on-site fire fighting equipment and procedure to be followed in event of fire.
 5. Maintain free access at all times to fire extinguisher equipment, street fire hydrants, and outside connections for standpipe hose systems.

- B. Maintain exit facilities and access thereto free of material and other obstructions. If any exits are rendered inoperative during remodeling, provide the same number of temporary exits and maintain a sufficient number of required exits and exit width as required by the adopted building code and AHJ.

1.30 NON-SMOKING POLICY

- A. Smoking will not be allowed within the building or associate traffic areas at any time.

1.31 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Walk-Thru inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.
- D. At completion of construction, remove fencing, guardrails, barricades, temporary signage and temporary coverings.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic Product Requirements.
 - 2. Product Options.
 - 3. Product Substitution Requirements.
 - 4. Direct Purchase Products.
 - 5. Product Delivery Requirements.
 - 6. Product Storage and Handling Requirements.
 - 7. Contractor's Product Selection Checklist.

1.2 DEFINITIONS

- A. Products: Defined as new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

1.3 BASIC PRODUCT REQUIREMENTS

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents.
- C. Obtain copies of standards when required by Contract Documents.
- D. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- E. The contractual relationship, duties, and responsibilities of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.4 PRODUCT OPTIONS

- A. Products Specified by Naming a Single Manufacturer and/or Model Number: Provide specified product only unless otherwise specifically permitted in the specifications.
- B. Products Specified by Naming Two or More Manufacturers: Provide specified products of manufacturers and models named only, meeting specifications and specified requirements unless otherwise specifically permitted in the specifications.
- C. Products Specified by Reference Standards or by Description Only: Provide any product meeting specified reference standard or description.
- D. Complete Contractor's Product Selection Checklist specified herein and submit to Architect of Record per requirements of Section 01330 no later than 30 days after construction completion date.
 - 1. Submit checklist in PDF format.

1.5 PRODUCT SUBSTITUTION REQUIREMENTS

- A. No substitutions permitted. Provide specified products only unless otherwise specified.

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1.6 DIRECT PURCHASE PRODUCTS

- A. Direct purchase products shall be purchased directly by the General Contractor from the Manufacturer or the Pre-Negotiated Supplier as specified in the individual Specifications Sections. Direct purchased products shall not be purchased by any subcontractor regardless of the discipline or subcontract involved in the installation.

1.7 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions. Deliver materials and equipment at such stages of work in order to expedite the Work and minimize storage requirements.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, and damage. Do not use damaged materials and equipment.

1.8 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Provide safe storage of products.
- B. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- C. For exterior storage of fabricated products, place on sloped supports, above ground.
- D. Provide off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation.
- F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide interchangeable components of the same manufacturer, for components being replaced.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

PART 3 - EXECUTION – not used

END OF SECTION

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Examination of existing conditions.
 - 2. General construction requirements.

1.2 EXAMINATION

- A. Verify existing conditions prior to bidding and commencement of Work. If discrepancies are found between what is shown on the Drawings and existing field conditions, notify the Owner's Construction Manager and the Architect to determine action to be taken to resolve differences.
- B. Existing utility locations shown are approximate. Field verify the exact location and depths of existing utilities (whether shown or not) prior to the submission of bid or the commencement of construction. Notify the Owner's Construction Manager of the discovery of existing utilities not shown or noted on Drawings.
- C. Field locate and verify property lines, easements, setbacks and restrictions. Obtain services of a Registered Surveyor to establish property lines and setbacks prior to the commencement of construction and flag property lines and setbacks.
- D. Verify grades and proposed final grades. If ramps, stoops, or stairs are installed, verify final grades surrounding the new construction and adjust stair risers, ramp lengths, limits of paving, etc., to accommodate the required ramp slope, riser heights, or paving areas. Conform to ADA requirements for ramps and stairs unless otherwise specifically noted.

1.3 GENERAL CONSTRUCTION REQUIREMENTS

- A. Perform work in a safe and workmanlike manner and in strict accordance with the local governing Building Code, National Electric Code, U.S. Dept of Justice Americans with Disabilities Act (ADA), and all applicable codes, regulations and ordinances having jurisdiction.
- B. Subcontractors shall be familiar with drawings and specifications in their related field. Failure to be acquainted with this knowledge will not relieve subcontractors the responsibility for performing the work properly. No additional compensation will be allowed due to conditions that occur through to failure to familiarize workers.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used

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END OF SECTION

01700-2

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements and limitations for cutting and patching Work.
 - 2. Products for patching and extending Work.
 - 3. Transitions and adjustments.
 - 4. Repair of damaged surfaces, finishes and cleaning.

- B. Related Requirements:
 - 1. Contract Between Owner and Contractor: Additional requirements for cutting and patching.
 - 2. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of hazardous construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 - 3. Section 01500 - Temporary Facilities and Controls: Temporary barriers.
 - 4. Section 02023 - Selective Site Demolition: Procedures for removing existing materials and equipment.

1.2 REFERENCES

- A. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions or provide equipment that suppresses dust.

1.4 PERFORMANCE REQUIREMENTS

- A. Cutting and patching shall be performed as required for cutting into existing construction to provide for installation or performance of other work and subsequent fitting and patching required for restoration of surfaces to their original condition.

- B. Cut into or partially remove portions of the existing building as required for new construction. Include such work as:
 - 1. Cutting, moving or removal of items shown to be cut, moved or removed.
 - 2. Cutting, moving or removal of items not shown to be cut, moved, or removed, but which must be cut, moved, or removed to allow for new construction. Work or items which are to remain in the finished work shall be patched or reinstalled after cutting, moving, or removal, and joints and finishes shall match adjacent or similar work.
 - 3. Removal of existing surface finishes as needed to install new work and finishes.
 - 4. Removal of abandoned items and removal of items rendered no longer required resulting from alterations such as abandoned piping and electrical conduits to nearest J-boxes.
 - 5. Repair or removal of dangerous or unsanitary conditions resulting from alterations work.

- C. Structural Work:
 - 1. Do not cut and patch structural work in manner resulting in reduction of load-carrying capacity or load and deflection ratio.

- D. Operational Limitations:
 - 1. Do not cut and patch in manner resulting in decreased performance, shortened useful life, or increased maintenance.

- E. Quality Limitations: Do not cut and patch work exposed to view (exterior and interior) in manner resulting in noticeable reduction of aesthetic qualities and similar qualities, as determined by the Owner's Construction Manager.
- F. Limitation on Acceptance: Owner's Construction Manager's acceptance to proceed with cutting and patching shall not waive right to later require removal or replacement of work found to be cut and patched in unsatisfactory manner as determined by the Owner's Construction Manager.
- G. Obtain all required inspections and approvals from authorities having jurisdiction for Temporary Certificate of Occupancy for Offices and Stockroom at least seven calendar days prior to Owner's scheduled move into new Office and Warehouse areas.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials for cutting and patching that are identical to existing materials. If identical materials are not available or cannot be used, use materials that match existing adjacent surfaces to fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal or better performance characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which work is to be performed before cutting. Take corrective action before proceeding with work if unsafe or otherwise unsatisfactory conditions are encountered.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut to prevent failure.
- B. Protection:
 1. Protect other work during cutting and patching to prevent damage.
 2. Provide protection from adverse weather conditions for that part of project that may be exposed during cutting and patching operations.
 3. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 4. Take precautions not to cut existing pipe, conduit, or duct serving building but scheduled to be relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING

- A. Remove, cut and patch work in a manner to minimize damage and to provide means of restoring products, materials, and finishes to match original condition.
- B. Cutting and removal work shall be performed so as not to cut or remove more than is necessary and that are least likely to damage work to be retained or adjoining work.
- C. Conduct work in such a manner as to minimize noise and to minimize accumulation and spread of dirt and dust.
- D. Use hand tools or small power tools designed for sawing or grinding. Avoid hammering and chopping.
- E. Where cutting cured concrete or masonry is required, use saws equipped with integrated water delivery systems that continuously feed water to the blade, or a HEPA-rated filter dust collection vacuum system recommended by the manufacturer to maintain dust emissions below the permissible level.

- F. Where core drilling or grinding concrete is required, use power tools equipped with HEPA-rated filter dust collection vacuum system recommended by the manufacturer to maintain dust emissions below the permissible level.
- G. To avoid marring existing finished surfaces, cut and drill from exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
- H. Cut holes and slots neatly to size required with minimum disturbance of adjacent work. Use HEPA-rated filter vacuums to clean holes and slots.
- I. Dispose of construction waste in accordance with the requirements of Section 01351.
- J. Patch with seams that are durable and as invisible as possible. Comply with specified tolerances for work.
- K. If the surrounding surface cannot be matched, repaint or recoat the entire surface to nearest corner or transition point.

3.4 TRANSITIONS

- A. Where new work abuts or aligns with existing work, provide a smooth and even transition. Patched work shall match existing adjacent work in texture and appearance.
- B. Where finished surfaces are cut in such a way that a smooth transition with new work is not possible, terminate the existing surface along a straight line at a natural line of division.
- C. Where two or more spaces are indicated to become one space, reconstruct ceilings to provide horizontal planes without breaks, steps or bulkheads.
- D. In cases of extreme change of ceiling or floor, obtain instructions from the Owner's Construction Manager as to method of making an acceptable transition.

3.5 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces which are damaged, discolored, or showing imperfections. Repair substrate prior to patching finish.
- B. Restore existing work that is damaged during construction to a condition equal to its condition at the time of the start of the Work.
- C. At locations in existing areas where partitions are removed, patch the floors, walls and ceilings with finish materials to match new finishes.
- D. Where plumbing is removed and capped below finish floor, core drill concrete floor as required using proper dust control methods as specified herein. Cap a minimum of 8" below floor. Patch hole with new concrete to match existing floor.

3.6 REMOVAL AND REPLACEMENT OF EXISTING WORK

- A. Remove existing items, services, finishes or surfaces as required for installation of new construction.
- B. Repair, re-route, and extend services, piping and conduit of existing items and equipment as required during construction operations for installation and operation of new items and equipment. When existing equipment to remain is removed or relocated, re-install as required for proper operation.

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END OF SECTION

01731-4

SECTION 01740 - CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cleaning and maintenance of site premises.
- B. Related Requirements:
 - 1. Section 01351 – Compliance:
 - a. Construction demolition waste management and disposal.
 - b. Disposal and removal of hazardous construction and demolition waste.

1.2 REGULATORY REQUIREMENTS

- A. Codes and Standards: Comply with applicable Federal, State and Local codes and regulations relative to environmental safety regulations.
- B. Hazards Controls: Store volatile waste in covered metal containers and remove from premises daily. Prevent accumulation of wastes which create hazardous conditions.
- C. Pollution Control:
 - 1. Do not burn or bury rubbish and waste materials on the project site.
 - 2. Do not disposal of volatile fluid wastes (such as mineral spirits, oil or paint thinner) in storm or sanitary sewer systems or into streams or waterways.
 - 3. Do not disposal of any toxic chemicals in storm or sanitary sewer systems. Comply with EPA requirements regarding disposal.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
- C. Cleaning materials shall be clearly labeled and safely stored when not in use. Maintain control of cleaning materials while in use. Do not leave unattended. No flammable materials or liquids may be stored in the building.

PART 3 - EXECUTION

3.1 GENERAL CLEANING REQUIREMENTS

- A. Oversee cleaning and ensure that building and grounds are maintained free from accumulations of waste materials and rubbish.
- B. In exterior work, sprinkle dusty debris with fine water mist to control accumulation of dust. Avoid puddling.
- C. Clean interior office areas when ready to receive finish painting and continuous floor cleaning until building is ready for occupancy as Directed by WMCM.
- D. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

- E. After building is enclosed, clean interior premises at frequency as directed by Construction Manager prior to construction start.
- F. After 28 day cure of warehouse concrete floor slabs, or as soon as allowed by any proprietary slab design engineer, provide continuous cleaning of floor slabs via floor scrubbers.
 - 1. For cleaning of completed slab areas greater than 200,000 SF, utilize a minimum of two scrubbers.
 - 2. Continue continuous daily cleaning of warehouse slabs to prevent build-up of dust and debris.
 - 3. Reduce cleaning to daily cleaning for any areas occupied early by Walmart. Continue daily cleaning of areas occupied early by Owner, coordinating exact extents with Walmart, until final cleaning is complete.

3.2 TRASH REMOVAL

- A. On a daily basis, clean work areas and access, and dispose of waste materials, rubbish and debris.
- B. Perform segregation of waste materials into the various classification and segregated materials.
- C. Do not allow waste materials, rubbish and debris to accumulate and become an unsightly or hazardous condition.
- D. Keep streets and access to site free of rubbish and debris.

3.3 FINAL CLEANING

- A. Execute final cleaning prior to final inspection as follows:
 - 1. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - 2. Clean all exterior and interior surfaces, whether exposed or not to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
 - 3. Remove tools, construction equipment, and surplus material from Project site.
 - 4. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures.
 - 5. Leave Project clean and ready for occupancy.
 - 6. Remove labels that are not permanent.
 - 7. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 8. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign substances.
- B. Execute final cleaning of the site prior to final inspection as follows:
 - 1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - 2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - 3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 4. Remove tools and machinery from Project site.
 - 5. Power wash all exterior patio slabs and entrance walks.
- C. Execute final cleaning of the building exterior prior to final inspection as follows:
 - 1. Clean debris from roofs, gutters, downspouts, and drainage systems.
 - 2. Clean all exterior wall surfaces to remove dirt.
 - 3. Clean all louver screens via manufacturer recommendations.
 - 4. Clean dirt and accumulated dust from all exterior surfaces.
 - 5. Clean both sides of transparent materials, including glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Clean frames as part of glass cleaning.
- D. Execute final cleaning of the office interior prior to final inspection as follows:
 - 1. Clean all interior floor surfaces.

2. Clean all interior doors and frames.
 3. Polish mirrors and glass with glass cleaner, taking care not to scratch surfaces.
 4. Clean all counters and transaction tops per manufacturer recommendations
 5. Immediately prior to possession, clean toilets thoroughly including each toilet fixture to a sanitary conditions free of stains.
 6. Clean all ceramic wall and floor tile surfaces using cleaning solutions compatible with any grout sealers and wipe dry to prevent surface film or residue.
 7. Clean water closets and sinks with scrubbing cleansers to remove stains and deposits.
 8. Clean and polish stainless steel accessories and toilet partitions to a spotless luster using soap, ammonia, or mild detergent and water. Apply with sponge or soft cloth, rinse with clear water, and wipe dry. As an alternate, use a commercial stainless steel cleaner and polish.
- E. Execute final cleaning of the warehouse interior prior to final inspection as follows:
1. Wipe all horizontal surfaces in the warehouse including, but not limited to, the bottom chord/flanges of roof structure, racking beams, girts, conveyor and other material handling equipment, hand railing, stair stringers, etc.
 2. Wipe top side of all fixtures and permanently installed equipment including but not limited to light fixtures, transformers, panelboards, dock equipment, etc.
 3. Commence final cleaning of slabs after completion of all overhead cleaning.
 4. Final clean all interior slabs with floor scrubbers where possible. Where floor scrubbers are not practical (i.e. under racks and around other obstructions), final clean with hand-operated scrubbers.
 5. Remove all debris from dock leveler pan. Sweep leveler plate broom clean then wet mop leveler plate. Sweep leveler pits broom clean.
 6. Vacuum all elevated resin deck slabs to remove dust and debris. After vacuum, lightly wet-mop with manufacturer recommend cleaning agent.
- F. In addition to cleaning requirements noted in the Mechanical and Electrical specifications, also execute final cleaning of mechanical and electrical systems prior to final inspection as follows:
1. Replace disposable air filters and clean permanent air filters of equipment operated during construction. Clean exposed surfaces of diffusers, registers, and grills.
 2. Clean ducts, blowers, and coils if units were operated without filters during construction.
- G. Employ skilled workmen for final cleaning.
- H. Prior to final completion or Owner possession, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas with the Owner's Construction Manager to verify that entire Work is clean.

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END OF SECTION

01740-4

SECTION 01770 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Closeout Procedures.
 - 2. Final Closeout Submittals.
 - 3. Closeout Document Submission.
 - 4. Record Letters of Conformance.
 - 5. Letters of Certification.
 - 6. Project Record Documents.
 - 7. Operations and Maintenance Data.
 - 8. Warranties and Bonds.
- B. Related Sections:
 - 1. Section 01740 – Cleaning. Requirements for final cleaning.

1.2 CLOSEOUT PROCEDURES

- A. Comply with closeout submittal requirements defined within individual Sections. Submittals procedures described herein shall apply unless otherwise described in individual Sections.
- B. When Contractor considers Work to be Substantially Complete, submit written certification to Owner’s Construction Manager as follows.
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected.
 - 3. Work is complete in accordance with Contract Documents.
 - 4. Work is ready for inspection.

1.3 FINAL CLOSEOUT SUBMITTALS

- A. Definition: Closeout submittals are submittals specified in the individual sections as “Closeout” and shall not be otherwise considered a closeout document regardless of the type of submittal. Submittals not classified as a closeout submittal shall be considered a regular submittal under the provisions of Section 01330. For example: Maintenance Data may, or may not, be classified as a closeout unless specifically identified as a closeout in the individual section Part 1 SUBMITTAL paragraph.
- B. Unless otherwise specified in the individual sections, submit closeout submittals to the Owner within 90 days after Substantial Completion of the Work.
- C. All closeout documents specified in the individual sections shall be submitted. Specific documents listed below shall be included separately in an Electronic Closeout Document Submission as specified hereinafter.
- D. Final closeout submittals shall be received and approved by Owner before final application for payment will be approved.

1.4 ELECTRONIC CLOSEOUT DOCUMENT SUBMISSION

- A. Submit closeout documents electronically through Owner’s online system. Documents included in Electronic Closeout Document Submission shall consist only of the items in the following numbered list. Note that all closeout documents are not necessarily included in the Electronic Closeout Document Submission. If any item is not applicable, include a “Not Applicable” sheet within the uploaded section of the Electronic Closeout Document Submission. The Electronic Contract Document Submission shall not be compiled based only on the brief

description of each item in the following list. It is compulsory that the individual sections and references be examined to comprehend the full description of the specific item to be included. Include the following:

1. Contractor's Statement of Warranty.
2. Copy of Certificate of Occupancy: Submit as Electronic Closeout Document by uploading an electronic file of the C of O to the [Walmart Quickbase Certificate of Occupancy Tracking Application](#).
3. Subcontractor Assignment: Submit a final list of Subcontractors used. Include the following information for each Subcontractor:
 - a. Daytime and after-hours telephone numbers.
 - b. Address.
 - c. Quarterly expenditure detail.
4. Signed and notarized lien waivers from Contractor and all Subcontractors on the Owner's form. The waivers shall have no modifications or changes made thereon.
5. Copies of Performance and Payment Bond.
6. Consent of Surety to Final Payment: From Bonding Company.
7. Substantial Completion Punchlist: Building, Civil, and HVAC/refrigeration punch lists showing items completed and approved by Owner. (Reference Article 5.2 of the Contract.)
8. Verification of transmittal to Facility Manager of all Project Record Documents specified hereinafter and Operations and Maintenance Manuals. This shall be in the form of a Letter of Transmittal with a statement signed by the Facility Manager verifying that the O&M manuals have been placed in the Maintenance Area by the Contractor and the placement witnessed by the Facility Manager and the Maintenance Operations Manager.
9. Letters of Certification: Include separate letter for each certification required within the sections listed below.
 - a. Polished Concrete Floor Finish (Existing Floors) (Section 03363)
10. Record Letters of Conformance: Include separate letter for each item listed below.
 - a. Contractor Quality Control (Section 01452)
 - b. Construction Testing Laboratory (Appendix B)
11. Warranties. Include warranties for the following as applicable when the specified Section is included in the project.
 - a. Termite Control: (Section 02361).
 - b. Membrane Roofing. Submit Roofing Warranty included at the end of Roofing Section (Section 07500). Manufacturer's standard warranty will not be considered as a substitute for the warranty included herein.
12. Inspection Reports: Include separate report for each required item listed below.
 - a. Building Automation Systems: (Section 13810)
 - 1) Pre-Checkout Forms.
 - 2) Checkout Forms.
 - b. Building Services Piping: (Section 15100)
 - 1) Video Inspection Report.
 - 2) Dye Testing Report (If specified).
 - c. Refrigeration Equipment (Section 15600).
 - 1) Start-up Report.
 - 2) Building Performance Report.
 - 3) Refrigerant Data Collections Forms.
 - 4) Documents will be distributed by Walmart Mechanical Services.
13. Copy of Notice of Termination of NPDES Construction General Permit with proof of submittal to appropriate agency. This is only applicable for those permits issued to the General Contractor. (See Section 02370, if specified).

- B. If Contractor fails to provide a fully completed Electronic Closeout Document Submission within 90 days after Substantial Completion of the Work, then Contractor agrees to pay Owner the sum of \$250.00 per day, as liquidated damages and not as a penalty, until the fully completed Electronic Closeout Document Submission is received and approved by Owner Contract Administration.

1.5 RECORD LETTERS OF CONFORMANCE

- A. Submit Record Letters of Conformance as a Closeout Submittal. By submitting Record Letter of Conformance, the Contractor declares that the product identified by manufacturer's name and model number is the product specified

and is suitable for the intended use as defined within the Contract Documents and has been provided and placed in operational condition in accordance with the manufacturer's published instructions and the Contract Documents.

1. Submit completed Record Letter of Conformance for each product selected as indicated within each Section.
2. Fill-in required information on form and sign in ink by person authorized to sign on behalf of the Contractor.
3. No modifications shall be made to the form.
4. Record Letters of Conformance, when required, are located at the end of the respective Section.

1.6 LETTERS OF CERTIFICATIONS

- A. Certify manufacturer's or installer's qualifications, conformance with tests or specified criteria, or other factors as required in individual specification sections.
- B. Submit supporting reference data, affidavits, and certifications as required.
- C. Number of Copies Required: Two.

1.7 PROJECT RECORD DOCUMENTS:

- A. Maintain on site, one set of the following record documents. Record actual revisions to the Work.
 1. Contract Drawings. (Building and Civil)
 2. Specifications.
 3. Addenda.
 4. Change Orders and other Modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
- B. Maintain Record Documents separate from documents used for construction.
- C. As-built Record Documents and Shop Drawings: Record as-builts shall be maintained and submitted for the primary purpose of recording the locations for concealed interior and exterior underground utilities as specified in the individual specifications. Legibly record actual measured horizontal and vertical locations of interior and exterior underground utilities and appurtenances, referenced to permanent surface improvements.
- D. Record required as-built information concurrent with construction progress. Do not permanently conceal work until required information has been recorded.
- E. At Project completion, the Contractor shall place the Record Documents (including Building and Civil Record Drawings, Specifications, Addenda, and Change Orders) enclosed in a plastic pipe tube (fixed cap at one end and a threaded-cap on the other end) for storage in the Electrical Room unless otherwise specified to be located in another location in the individual Sections. Placement shall be in the presence of and witnessed by the Facility Manager.

1.8 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance data shall include a suitably bound set of descriptive literature, maintenance and operation data, and parts lists for each item of equipment provided under this Contract that will require maintenance or special operation procedures, including drawings, instructions, or manuals supplied with equipment furnished by others and installed under this Contract. Submittal of O&M data shall be in the form of placement by the Contractor of the bound set of O&M data in the Electrical Distribution Center (EDC) within the building. Do not include O&M data in the Closeout Document Book or submit to Walmart Contract Administration. Placement of documents shall be witnessed by the Facility Manager and shall be at least 14 days prior to final inspection.

1.9 WARRANTIES AND BONDS

- A. Prior to Final Application for Payment, submit required warranties and bonds in Closeout Document Submission.
 1. Assemble documents from Subcontractors, suppliers, and manufacturers.
 2. For equipment put into use with Owner's acceptance during construction, submit within ten days after first operation, listing date of acceptance as start of warranty period.

3. For items of Work delayed materially beyond Date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

END OF SECTION

WALMART AFFIDAVIT OF TOTAL RELEASE AND CERTIFICATION OF ALL BILLS PAID

Replaced by Contract Par 5.3.2 and Exhibits.

01770-5

[CONTRACTOR'S LETTERHEAD]

CONTRACTOR'S STATEMENT OF WARRANTY

DATE:

PROJECT:

LOCATION:

OWNER: Walmart Stores, Inc.
702 SW 8th Street
Bentonville, AR 72712

CONTRACT: Construction Agreement Between Walmart and Contractor, dated _____ 20____.

General Contractor hereby: (1) warrants that the Work for Project complies with Article 3.4 of the Construction Contract; (2) acknowledges that its warranty obligations under such Article 3.4 extends one year beyond the actual date of Substantial Completion of the Project; and (3) affirms, and acknowledges the enforceability of, all other warranties made by Contractor in the Contract.

Terms used but not defined herein shall have the meanings given to them in the above referenced Contract.

The undersigned Contractor hereby makes the certifications set forth herein to Walmart as of the _____ day of _____, 20____.

Witness: _____ Contractor: _____

_____ By: _____

Print Name: _____ Name: _____

Title: _____

STATE OF _____
COUNTY OF _____

On this the _____ day of _____, 20____
before me, a Notary Public, within and for the State and County aforesaid, personally appeared, to me well know (or proved to me on the basis of satisfactory evidence), who stated upon oath that (s)he had executed the foregoing instrument for the consideration set forth therein.

Notary Public
My commission expires: _____

SECTION 02230 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cleaning site of debris, grass, trees, and other plant life in preparation for site or building earthwork.
 - 2. Protection of existing structures, trees, or vegetation indicated on the Construction Drawings to remain.
- B. Related Requirements:
 - 1. Section 02220 – Site Demolition: Demolition and removal of structures, paving, utilities and other improvements.
 - 2. Section 02300 – Earthwork: Stripping and removal of topsoil.
 - 3. Section 02370 - Erosion And Sedimentation Control (Including SWPPP)

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Construct temporary erosion and sediment control systems as shown on Construction Drawings and as directed by the "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation.
- B. In event
that sitework on this project will disturb one or more acres, starting work shall be strictly governed by the sequence of construction as specified in Section 02370 and SWPPP site maps. Contractor shall not begin construction without "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction.
- C. Clearing and grubbing shall commence in the proper sequence as stated in the Phase I of the Best Management Practice Sequence specified in Section 02370 and on the SWPPP site map and subsequent to the halt in construction for performance of the inspection and certification of BMPs as stated.
- D. Contractor shall conduct storm water management practices in accordance with the project SWPPP and applicable NPDES permit and shall enforce action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.

1.3 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify existing plant life that is to remain and verify clearing limits are clearly tagged, identified, and marked in such manner as to ensure their protection throughout construction operations.

3.2 PROTECTION

- A. Locate, identify, and protect existing utilities that are to remain.
- B. Protect trees, plant growth, and features designated to remain as part of final landscaping.
- C. Conduct operations with minimum interference to public or private accesses and facilities. Maintain ingress and egress at all times and clean or sweep roadways daily as required by SWPPP or governing authority. Dust control shall be provided with sprinkling systems or equipment provided by Contractor.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, in kind.
- E. Provide traffic control as required, in accordance with the US Department of Transportation's "Manual on Uniform Traffic Control Devices" and applicable state highway department requirements.

3.3 EQUIPMENT

- A. Material shall be transported to and from the project site using well-maintained and operating vehicles. Transporting vehicles operating on site shall stay on designated haul roads and shall not endanger improvements by rutting, overloading, or pumping.

3.4 CLEARING

- A. Clear areas required for access to site and execution of work.
- B. Unless otherwise indicated on Construction Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations shall be filled to subgrade elevation to avoid ponding of water. Satisfactory fill material shall be placed in accordance with Section 02300.
- C. Remove grass, trees, plant life, stumps, and other construction debris from site to dump site that is suitable for handling such material according to state laws and regulations.
- D. Cut heavy growths of grass from areas before stripping and topsoil removal and remove cuttings with remainder of cleared vegetative material.

END OF SECTION

SECTION 02251 - SHORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shoring at excavations and building structural and non-structural elements required to provide temporary support during excavating, demolition, and construction operations.
2. Temporary protection including without limits for construction workers, materials, existing construction other adjacent properties, and public.

B. Related Sections:

1. Section 01700 - Execution Requirements: Requirements and limitations for cutting and patching Work.
2. Section 01731 - Cutting and Patching.
3. Section 02023 - Selective Site Demolition: Procedures for demolition and removal of existing building elements.

1.2 DESIGN REQUIREMENTS

- A. Design and provide shoring to safely prevent collapse of materials and structures and to permit construction operations to proceed in conformance with construction sequence phases indicated on Drawings.

1.3 QUALITY ASSURANCE

- A. Provide design of shoring by professional civil or structural engineer licensed in State in which project is located. Send design to Owner's Construction Manager for documentation of this service.
- B. Coordinate shoring design and construction with:
 1. Soil Investigation Report prepared for this project (if applicable).
 2. Building structural system, including without limits to locations of footings, columns, pilasters, walls, and other related structural elements.
- C. Comply with pertinent requirements of Authorities Having Jurisdiction (AHJ).
- D. The Contractor shall be responsible for means and methods of shoring and temporary support and for the sequences and procedures to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials as required for shoring system design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas where Work under this Section will be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Starting Work constitutes acceptance of existing conditions. Be responsible for correcting unsatisfactory and defective Work encountered after starting Work.

3.2 INSTALLATION

- A. Install shoring system in accordance with shoring design drawings.
- B. Coordinate placement of shoring system elements with existing Work and approved demolition procedures as specified in Section 02023.
- C. Perform cutting and patching required by installation of shoring in accordance with approved Cutting and Patching Procedures and Sequencing Plan as specified in Section 01731.

3.3 FIELD QUALITY CONTROL

- A. Shoring Design Engineer: Inspect and approve shoring materials and installation prior to start of any demolition work.
- B. Submit inspection report to Owner's Construction Manager.

END OF SECTION

SECTION 02361 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil treatment for termite control.
 - 2. Application below grade and at interior and exterior foundation perimeter.

1.2 REFERENCES

- A. Environmental Protection Agency (EPA):
 - 1. EPA - Federal Insecticide, Fungicide and Rodenticide Act.

1.3 DEFINITIONS

- A. Termiticide: EPA-Registered product complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentration that dilutes with water or foaming agent, and formulated to prevent termite infestation.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the Work of this Section and licensed in accordance with regulations of authorities having jurisdiction for application of termiticide.
- B. Materials: Provide certification that termiticide is EPA approved and conforms to requirements of authority having jurisdiction.
- C. Regulatory Requirements: Conform to applicable requirements for application licensing and authority to use termite control chemicals.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect Products.
- B. Deliver Products in manufacturer's original unopened containers with labels intact, identifying Product and manufacturer, application instructions, and EPA federal registration number.
- C. Do not store Products on site. Deliver Products to site at time of application.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Environmental Requirements: Do not apply termiticide to frozen or wet soils or during rain or snow.

1.7 WARRANTY

- A. Submit written warranty signed by termite control applicator and Contractor certifying that applied chemical termiticide treatment will prevent infestation of subterranean termites.
 - 1. State that application was made at concentration, rates, and methods recommended.
 - 2. State that if subterranean termite activity is discovered during warranty period, Contractor will retreat soil and repair damage caused by termite infestation at no additional cost to Owner.
- B. Cover against invasion or propagation of subterranean termites, damage to building or building contents caused by termites; repairs to building or building contents so caused.

- C. Provide for inspection of Work annually; report in writing to Owner.
- D. Warranty Period: 5 years.
 - 1. Owner reserves right to renew warranty for an additional 5 years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. EPA and local authority having jurisdiction approved chemical termiticide; water based emulsion, uniform composition, with synthetic dye to permit visual identification of treated soil, bearing Federal registration number of the EPA.
 - 1. Do not use fuel oil as diluent.
- B. Specially formulated to prevent infestation by termites.

2.2 MIX DILUTION

- A. Dilute and mix chemical termiticide to manufacturer's published instructions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces and adjacent areas to be treated. Report conditions that may adversely affect satisfactory execution of Work to Construction Manager. Do not proceed with Work until unsatisfactory conditions have been corrected.
 - 1. Verify the soil surfaces are unfrozen, sufficiently dry to absorb termiticide, ready to receive treatment.
- B. Beginning of application means acceptance of existing soil conditions.

3.2 PREPARATION

- A. Remove foreign matter, loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations.

3.3 APPLICATION

- A. Apply termiticide within 12 hours before installation of vapor retarder under slab-on-grade or finish grading outside foundation walls.
- B. Apply termiticide to soil using metered applicator. Apply at rates and concentration recommended by the chemical manufacturer's written instruction.
- C. Apply at the following locations:
 - 1. Under Floor Slabs-On-Grade.
 - 2. Both Sides of Foundation Wall.
 - 3. Exterior Foundation: Apply along outside edge of building.
 - a. Dig trench 6 inches to 8 inches wide along outside of foundation to minimum depth of 12 inches and apply termiticide.
 - b. Mix termiticide with soil as it is being backfilled.
 - 4. Foundation Penetrations.
- D. Apply as a coarse spray; provide uniform distribution.
- E. Post signs in areas of application to indicate termite-treated areas. Remove signs after areas are covered by other construction.

- F. Reapply termiticide to areas disturbed by subsequent excavation, landscape grading, or other construction activities occurring after initial termiticide application.

3.4 CONSTRUCTION

- A. Interface with Other Work:

- 1. Coordinate application of termiticide at foundation perimeter with finish grading and landscaping work to avoid disturbance of treated soil.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test soil areas where termiticide was applied to determine the presence of any remaining termites before covering with subsequent construction.
- B. Reapply termiticide to areas where inspection or testing identifies the presence of termites. Use same termiticide as for original treatment.

3.6 CLEANING

- A. Execute in accordance with termiticide manufacturer's instructions and current environmental regulations.

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END OF SECTION

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SECTION 02220 (02 4100) - SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition of structures, paving, and utilities.
 - 2. Filling voids created as a result of removals or demolition.
- B. Related Requirements:
 - 1. Section 01351 – Regulatory Compliance:
 - a. Construction demolition waste management and disposal. (Formerly included in Section 01742)
 - b. Disposal and removal of hazardous construction and demolition waste. (Formerly included in Section 01743)
 - c. Work practice control methods for airborne respirable dust.
 - d. Removal and Recycling of Vinyl Composition Tile (VCT) (Formerly included in Section 02223).
 - e. Removal and Recycling of Acoustical Ceiling Tile (ACT) (Formerly included in Section 02224).
 - 2. Section 02230 - Site Clearing: Clearing of trees and other plant vegetation
 - 3. Section 02300 - Earthwork: Placement of fill material
 - 4. Section 02370 - Erosion and Sedimentation Control (Including SWPPP): Erosion protection during demolition operations.
 - 5. Appendix B – Testing, Inspection, and Observation by Owner (includes 01456 CEC Site Observation Requirements).

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, runoff control, and pollution prevention.
- B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct public or private roadways, sidewalks, or fire hydrants without appropriate permits or written authorization.
- E. If hazardous, contaminated materials or other environmental related conditions are discovered, stop work immediately and notify the Walmart Construction Manager for action to be taken. Do not resume work until specifically authorized by the Construction Manager.
- F. Comply with the requirements of Section 01351 Regulatory Compliance Supplement for hazardous construction and demolition waste management and disposal.
- G. Test soils around buried tanks for contamination. Coordinate notification for mobilization to site and required observation of tank removal with Walmart Civil Engineering Consultant.

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1.4 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.5 PROJECT CONDITIONS

- A. Structures to be demolished will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.
- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.
- E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill material shall be aggregate fill materials as specified in Section 02300.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide, erect, and maintain erosion control devices, temporary barriers, and security devices at locations indicated on Construction Drawings.
- B. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage to existing items to remain caused by demolition operations.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.
- D. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.
- E. Notify adjacent property owners of work that may affect their property, potential noise, utility outages, or other disruptions. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property. Coordinate notice with Owner.

3.2 GENERAL DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures or pavements to remain.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed by authority.

- C. Conduct operations with minimum of interference to public or private access. Maintain ingress and egress at all times.
- D. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.
- E. Comply with governing regulations pertaining to environmental protection.
- F. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.3 DEMOLITION

- A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- B. Disconnect and cap or remove utilities to be abandoned as shown on the drawings.
- C. Fill or remove underground tanks, piping, and appurtenances as shown.
- D. Demolish buildings completely and remove from site using methods as required to complete work within limitations of governing regulations. Small structures may be removed intact when acceptable to Owner and authorities having jurisdiction.
- E. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.
- F. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2-feet or more below proposed subgrade to permit moisture drainage. Remove slabs-on-grade and below grade construction within 2-feet of proposed subgrade. Use proper dust control methods to maintain dust emissions below the permissible level.

3.4 FILLING BASEMENTS AND VOIDS

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in accordance with Section 02300 unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from site debris, rubbish, and other materials resulting from demolition operations. Leave areas of work in clean condition.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate governing authority and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

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3.6 CIVIL ENGINEERING CONSULTANT (CEC) OBSERVATION

- A. Civil Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

SECTION 02821 - CHAIN LINK FENCES AND GATES (BUILDING RELATED)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building related chain link fence.
 - 2. Chain link gates.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 03310 - Structural Concrete and Exterior Concrete Slabs: Concrete anchorage for posts.
 - 2. Section 05090 - Post-installed Concrete and Masonry Anchors: Anchors for interior fence posts.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- C. Chain Link Fence Manufacturers Institute (CLFMI): Product Manual.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Fencing system and installation engineered to withstand 93 mph windload assuming 50 percent coverage with hanging plastic banners and signage.

1.4 QUALITY ASSURANCE

- A. Chain link fabric, posts, and components, and installation shall conform with the requirements of the CLFMI Product Manual unless otherwise shown or specified.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Posts: Type I or II or roll formed "C" Section steel conforming to CLFMI and as specified hereinafter.
- B. Fabric: No. 9 gage galvanized steel wire mesh; ASTM A 392, height as shown.
 - 1. Mesh Size: 2 inch.
 - 2. Mesh Size: Security fabric where noted on Drawings: 1 inch.
 - 3. Fabric height less than 72 inches: Top and bottom selvages knuckled.
 - 4. Fabric height 72 inches and greater: Top selvage twisted, bottom selvage knuckled.

2.2 COMPONENTS

- A. End, Corner, and Pull Posts: Minimum sizes and weights as follows unless otherwise shown.
 - 1. Up to 13 Foot Fabric Height: Type I or II in accordance with CLFMI Product Manual.

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2. 13 foot and over Fabric Height:
 - a. Type I Posts: Round; 4.0 inch outside diameter pipe, 9.10 lbs/lin ft.
 - b. Type II Posts: 4.0 inch outside diameter pipe, 6.56 lbs/lin ft.
- B. Line (Intermediate) Posts: Minimum sizes and weights as follows unless otherwise shown.
 1. Up to 8 Foot Fabric Height: Type I, II, or "C" Section in accordance with CLFMI Product Manual.
 2. Over 8 Foot Fabric Height:
 - a. Type I Posts:
 - 1) Round: 2.875 inch outside diameter pipe, 5.79 lbs/lin ft.
 - 2) Square: 2.5" x 2.5" outside dimension, 5.10 lbs/lin ft.
 - b. Type II Posts: 2.875 inch outside diameter pipe, 4.64 lbs/lin ft.
- C. Gate Posts: Type I or II in accordance with CLFMI Product Manual unless otherwise shown.
- D. Top, Bottom, and Intermediate Rails: Manufacturer's longest lengths.
 1. Type I or II in accordance with CLFMI Product Manual.
 2. Couplings: Expansion type, approximately 6 inches long.
 3. Attaching Devices: Means of attaching top rail securely to each gate, corner, pull, and end post.
 4. Do not install bottom rail at truck well fence which shall receive tension wire instead.

2.3 ACCESSORIES

- A. Sleeves: Galvanized steel pipe with inside diameter not less than 1/2 inch greater than outside diameter of fence posts. Provide steel plate closure welded to bottom of sleeves of width and length not less than 1 inch greater than outside diameter of sleeve.
 1. Up to 6 Foot Fabric Height: Provide sleeve not less than 12 inches long.
 2. Over 6 Foot Fabric Height (Not for Partitions Tight to Roof Deck): Provide sleeve not less than 24 inches long.
 3. Fabric Installed Tight to Roof Deck (Posts Braced to Roof Structure): Provide sleeve not less than 12 inches long.
- B. Tension Wire: 7 gage steel, metallic-coated coil spring wire, located at bottom of fence fabric.
- C. Wire Ties: 11 gage galvanized steel.
- D. Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same materials as top rail for brace, and truss to line posts with 0.375 inch diameter rod and adjustable tightener.
- E. Post Tops: Galvanized steel, weather tight closure cap for tubular posts, one cap for each post. Furnish cap with openings to permit passage of top rail as required.
- F. Stretcher Bars: Galvanized steel, one piece lengths equal to full height of fabric; with minimum cross section of 3/16 x 3/4 inch. Provide one stretcher bar for each gate and end post, and two for each corner and pull post.
- G. Stretcher Bar Bands: Manufacturer's standard.
- H. Gate Cross-Bracing: 3/8 inch diameter galvanized steel adjustable length truss rods.
- I. Gate Hardware:
 1. Swinging Gate Hardware:
 - a. Hinges:
 - 1) Size and material to suit gate size; offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6'-0" nominal height.
 - 2) Auto Center Service Area Gate: Hinges shall be Tru-close self closing round post gate hinges by D&D Technologies USA, Costa Mesa, CA (800) 716-0888.

- b. Latch:
 - 1) Exterior: Forked type or plunger-bar type to permit operation from both sides of gate, with padlock eye.
 - 2) Interior: Forked type to permit operation from both sides of gate. Omit any type of padlock device and substitute standard pin bracket for attachment of forked latch (gates are not to be padlocked).
 - 3) Auto Center Service Area Gate: Butterfly gate latch No. 17307 by Master-Halco or No 5552 by Merchant Metals.
- 2. Double Gate Hardware: In addition to the above, provide gate stops for double gates, consisting of mushroom type flush plate with anchors set in concrete to engage center drop rod or plunger bar. Configure for use of one padlock to lock both gate leaves on exterior gates.
- 3. Cantilever Sliding Gate Hardware: Manufacturer's standard heavy duty cantilever sliding gates including the following:
 - a. Track/rail and guide assembly.
 - b. Gate hangers, latches, brackets, bracing, and stops.
 - c. Bottom wheel assemblies.

2.4 SETTING MIXES

- A. Concrete: See Section 03310.
- B. Grout: Premixed, factory-packaged, non-staining, non-corrosive grout. See Section 03310. Provide type specially formulated for exterior application.

2.5 GATE FABRICATION

- A. Fabricate gate frames of min. 1.90 inch outside diameter galvanized steel pipe. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories. Space frame members maximum 8'-0" apart.
- B. Assemble gate frames rigidly by welding or with special fittings and rivets. Use same fabric as specified for fence. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to frame at not more than 15 inches on center. Install diagonal cross-bracing on gates as required to ensure frame rigidity without sag or twist.
- C. Attach fabric on sliding gates to maintain bottom clearance as specified below in Installation.
- D. Attach hardware to provide security against removal or breakage.

2.6 FINISH

- A. Fabric and Framing: Zinc coated in accordance with CLFMI Product Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install chain link fence in accordance with CLFMI Product Manual unless otherwise specified herein.
- B. Space line posts 10'-0" on center maximum, except as otherwise indicated.
 - 1. Space line posts at 8'-0" on center maximum if plastic slats are indicated to be installed in fence fabric.
 - 2. Space interior line posts 8'-0" on center maximum.
- C. Set posts as close to building walls as practical. Gaps greater than 1 inch between wall and posts shall be closed with a metal closure panel attached full height to post with Tek screws as shown. Hem edges and corners of sheet metal to eliminate sharp or rough edges.

- D. Methods for Setting Posts:
1. Grade-Set Posts:
 - a. Drill or hand excavate to a depth approximately 3 inches lower than post bottom. Set post bottom at depth indicated on Drawings.
 - b. Excavate each post hole to 12 inch diameter, or not less than four times diameter of post.
 - c. Hold post in position while placing, consolidating, and finishing concrete.
 - d. Post shall be set plumb within 1/4" in 10 feet.
 2. Sleeve-Set Posts In Slabs: Anchor posts in concrete by means of pipe sleeves preset into concrete to depth not less than 24 inches below finish slab, and anchored into concrete. Insert posts into sleeves and fill annular space between post and sleeve solid with grout. Mix and place grout in accordance with manufacturer's published instructions.
- E. Intermediate Rails: Provide center and bottom rails where indicated. Install in one piece between posts and flush with post on fabric side, using offset fittings where necessary. Place intermediate rails a maximum of 6 feet on center.
- F. Brace Assemblies: Install braces so posts are plumb with rod in tension.
- G. Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 gage galvanized wire. Fasten fabric to tension wire using 11 gage galvanized steel hog rings spaced 24 inches on center.
- H. Fabric: Space between bottom of fabric and finish grade shall be not greater than 2 inches. Space between bottom of fabric and finish grade shall not be greater than 1/2-inch on sliding gates. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so fabric remains in tension after pulling force is released.
- I. Stretcher Bars: To secure end, corner, pull, and gate posts, thread through or clamp to fabric 4 inches on center and secure to posts with metal bands spaced 15 inches on center.
- J. Tie Wires:
1. Use U-shaped wire conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted two full turns. Bend wire ends to minimize hazards to persons or clothing.
 2. Tie fabric to line posts with wire ties spaced 12 inches on center. Tie fabric to rails and braces with wire ties spaced 24 inches on center. Manufacturer's standard procedure will be accepted if of equal strength and durability.
- K. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- L. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.2 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch.
- B. Maximum Offset from True Position: 1 inch.

END OF SECTION

SECTION 03310 (03 3100) – STRUCTURAL CONCRETE AND EXTERIOR CAST-IN-PLACE CONCRETE SLABS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast in place structural concrete for concrete structures including the following:
 - a. Footings.
 - b. Foundation stem walls.
 - c. Retaining walls.
 - d. Column pedestals.
 - e. Monument sign foundations.
2. Cast in place non-structural concrete including the following:
 - a. Dock leveler pit slab.
 - b. Door stoops.
 - c. Exterior sidewalks adjacent to building and entry slab.
 - d. Exterior slabs shown on the architectural and structural drawings.
 - e. Exterior concrete equipment pads shown on the architectural and structural drawings
 - f. Interior concrete curbs and equipment pads.
 - g. Exterior concrete stairs.
 - h. Exterior steel column encasement.
3. Aggregate base below slab.
4. Formwork, shoring, bracing, and anchorage.
5. Reinforcement and accessories.
6. Curing and finishing.

B. Related Requirements:

1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of hazardous construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
2. Section 02715 - Base Course: Base for exterior concrete slabs except as otherwise specified herein.
3. Section 03314- Cast-In-Place Concrete Slabs: Concrete for interior slabs on ground except as specified above.
4. Section 05120 - Structural Steel: Column anchor bolts.
5. Section 05500 - Metal Fabrications: Other metal components cast into concrete.
6. Section 07210 – Building Insulation: Foundation insulation.
7. Section 07900 - Joint Sealers: Expansion, Contraction, and Construction Joint Fillers and Sealants.
8. Appendix B – Testing, Inspection and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Mandatory Provisions: In publications referred to herein, advisory provisions shall be considered to be mandatory.
- C. American Association of State Highway and Transportation Officials (AASHTO): Standard Specification For Transportation Materials And Methods Of Sampling and Testing :
 1. AASHTO T318 - Water Content of Freshly Mixed Concrete Using Microwave Oven Drying (Formerly AASHTO TP 23)
- D. American Concrete Institute (ACI):
 1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
 2. ACI 301 - Structural Concrete.

3. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
4. ACI 304.2R - Placing Concrete By Pumping Methods.
5. ACI 305.1 - Hot Weather Concreting.
6. ACI 306.1 - Cold Weather Concreting.
7. ACI 308.1 - Curing Concrete.
8. ACI 308R - Guide To Curing Concrete.
9. ACI 315 - Details and Detailing of Concrete Reinforcement.
10. ACI 347 - Guide To Formwork For Concrete.
11. ACI 347R - Formwork for Concrete.
12. ACI SP66 - ACI Detailing Manual.

E. ASTM International (ASTM):

1. ASTM A36 – Carbon Structural Steel.
2. ASTM A82 - Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A185 - Steel Welded Wire Fabric, Plain, for Carbon Steel, 60,000 PSI Tensile Strength Concrete Reinforcement.
4. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A706 - Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
6. ASTM C33 - Concrete Aggregates.
7. ASTM C94 - Ready-Mixed Concrete.
8. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates
9. ASTM C150 - Portland cement.
10. ASTM C171 - Sheet Materials for Curing Concrete.
11. ASTM C260 - Air-Entraining Admixtures for Concrete.
12. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
13. ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance
14. ASTM C494 - Chemical Admixtures for Concrete.
15. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
16. ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
17. ASTM C881 - Epoxy-Resin-Base Bonding Systems For Concrete
18. ASTM C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
19. ASTM C 1218 - Water-Soluble Chloride in Mortar and Concrete.
20. ASTM C1315 - Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete.
21. ASTM D 98 - Calcium Chloride.
22. ASTM D 698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.49 Kg) Hammer and 12-in (305 mm) Drop.
23. ASTM D1241 - Materials for Soil-Aggregate Subbase, Base and Surface Courses
24. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
25. ASTM D1752: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
26. ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
27. ASTM D3575: Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.
28. ASTM E96 - Water Vapor Transmission of Materials
29. ASTM E154 - Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls or as Ground Cove.

F. America Plywood Association (APA):

1. Grading Rules.

G. American Welding Society (AWS):

1. AWS D1.4 - Structural Welding Code Reinforcing Steel.

H. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI Manual of Standard Practice.

2. CRSI Placing Reinforcing Bars.

- I. Department of Commerce (National Institute of Standards and Technology) – Product Standard (DOC):
1. DOC PS 1 - Construction and Industrial Plywood.

- J. International Code Council, Inc.:
1. International Building Code (IBC).

- K. National Concrete Ready-Mix Association:
1. NCRMA Inspection Standards

- L. Occupational Safety and Health Administration (OSHA):
1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions or provide equipment that suppresses dust.

1.4 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330.
- B. Submit all submittals electronically in PDF format via email, unless otherwise specified, to Architect of Record.
- C. Submit submittal items required within this section concurrently. Do not submit submittals of this section together with submittals in section 03314 or any other section. Identify submittals explicitly in accordance with Procedures paragraphs in Section 01330.
- D. Sieve Analysis for Aggregate Base: Submit current sieve analysis report, sampled and tested within the last 60 days of submittal date, for aggregate base and choker material.
- E. Concrete Batch Plant Certifications: Submit name and address of the concrete supplier's batch plant and plant certification(s) by National Ready-Mix Concrete Association and/or State Department of Transportation.
- F. Shop Drawings: Submit shop drawings within 5 working days of Contract Date. Do not use reproductions of Contract Documents as shop drawings. Prepare shop drawings in accordance with Part B, Chapter 3, ACI 315.
1. Reinforcement:
 - a. Include concrete notes on shop drawings that relate to proper placing of reinforcing.
 - b. Show all reinforcing steel including dowels, embedded steel items, and anchor bolts.
 - c. Include number, grade, size, length, mark, location, splice lengths, and bending diagrams for reinforcing steel and related products.
 2. Placement Drawings:
 - a. Submit reinforcement placement drawings with bar lists. Include walls, grade beams, and plans of footings and slabs.
 - b. Show section cuts, details with piece marks, and control joint locations. Show reinforcing size, quantity, spacing, location, length, and required schedules.
- G. Mix Design: Submit Concrete Mix Design Submittal Form included at end of this Section.
1. Submit separate mix design for concrete to be placed by pumping in addition to the mix design for concrete to be placed directly from the truck chute.
 2. Submit mix design by email to Architect and the Owner's Construction Testing Laboratory (CTL). Include applicable information shown on the Mix Design Submittal Form including the following:
 - a. Proportions of cementitious materials, fine and coarse aggregate, and water.
 - b. Water-cementitious material ratio, 28-day compressive design strength, slump, and air content.
 - c. Type of cement, fly ash, slag, and aggregate.
 - d. Individual aggregate gradation.

- e. Type and dosage of admixtures.
 - f. Special requirements for pumping.
 - g. Range of ambient temperature and humidity for which design is valid.
 - h. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
 - i. Materials and methods for curing concrete
- H. Attachments to Concrete Mix Design: Submit the following as attachments to be included with the Concrete Mix Design:
- 1. Cementitious materials mill test reports for the following:
 - a. Portland cement.
 - b. Fly ash.
 - c. Slag.
 - 2. Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials.
 - 3. Sieve Analysis Reports for Concrete Aggregate: Provide separate reports of particle distribution, calculating cumulated percentages passing for all individual aggregates required on the mix form. Sieve analysis sampling and testing for each aggregate source shall be conducted within 60 days of concrete submittal date.
 - 4. Aggregate Supplier Statement:
 - a. Stating if aggregate is possibly alkali-reactive based on tests or past service.
 - b. Stating if aggregate can possibly cause pop-outs, "D" cracking, or other disruptions due to moisture gain, freezing, or other mechanisms, based on tests or past service.
 - 5. Product data for the following concrete materials admixtures:
 - a. Air entraining.
 - b. Water reducing.
 - c. Water reducing and retarding.
 - d. Accelerating.
 - e. Evaporation retarding.
 - f. High-range water reducing.
 - g. Chloride ion content for each admixture.
 - 6. Chloride-Ion Content: Measured water-soluble chloride-ion content (percent by weight of cementitious materials) in accordance with ASTM C 1218.
 - 7. Concrete compressive strength data as required by ACI 301.
 - 8. Past compression test reports on each mix as required by ACI 301.
 - 9. Time of Initial Setting: Initial setting time in accordance with ASTM C403.
- I. Product Data: Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Architect of Record and the Construction Testing Laboratory for review and approval and within 5 working days of Contract.
- 1. Portland cement concrete mix design(s).
 - 2. Type and source of Portland cement, fly ash, and/or slag
 - 3. Aggregate gradations
 - 4. Soft preformed joint filler
 - 5. Pavement joint sealant
 - 6. Dowel bars
 - 7. Tie bars
 - 8. Reinforcing steel bars
 - 9. Welded wire fabric
- J. Pumped Concrete Supplier Statement: Submit statement as described in Quality Assurance paragraph below.
- K. Delivery Tickets:
- 1. Copies of delivery tickets for each load of concrete delivered to site.
 - 2. Indicate information required by ASTM C 94 on each ticket including additional information required for slabs.
 - 3. Information on ticket shall include quantities of material batched including the amount of free water in the aggregate and the quantity of water that can be added at the site without exceeding the maximum water

- cementitious ratio of the approved mix design. Aggregate moisture corrections shall be based on ASTM definitions of aggregate moisture content and absorption.
4. Mix identification number on ticket shall match number on submitted and approved mix design.
 5. Submit copies to Owner Testing Laboratory with each concrete delivery.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
1. ACI 301 - Specifications for Structural Concrete for Buildings.
 2. CRSI - Manual of Standard Practice.
- B. Pumped Concrete:
1. Perform mix design, proportioning, and placement in accordance with ACI 304.2R.
 2. Submit documented evidence of experience in placing concrete by pumping on not less than three projects of similar size and complexity. List available pump size, standby pump size, piping, and other equipment.
 3. Submit documented evidence of concrete supplier's ability to dedicate sufficient mixing and delivery equipment to supply the concrete continuously for the volumes to be placed by pumping.
- C. Chemical Admixtures: Set control admixtures may be used only when adverse weather conditions are anticipated. Use of admixtures is subject to Owner approval.
1. Notify Owner Construction Manager at Pre-Bid Conference if admixtures will be used in concrete.
 2. Provide Owner Construction Manager with proposed Construction Schedule identifying anticipated adverse weather conditions justifying use of admixtures.
 3. Notify Owner Construction Manager prior to installation for which admixtures will be used in concrete.
 4. Mix design shall indicate ingredients including the admixtures to be used and the slump and air content range for the project.
- D. Concrete Truck Inspection:
1. Conform to ASTM C94, NRMCA, and Department of Transportation standards in state where project is located.
 2. Perform inspections immediately before starting concreting operations.
 3. Record acceptable truck numbers.
 4. Record the identification numbers of those trucks found to be acceptable on the basis of inspections.
 5. Do not bring on site for concreting operations, any truck whose identification numbers are not recorded as acceptable. Notify Owner Testing Lab if non-conforming trucks are used to deliver concrete for slabs and pavements.
- E. Concrete Supplier Approval:
1. The concrete supplier shall be fully approved and acceptable by the concrete subcontractor as the producer of concrete for which the subcontractor is to place and finish. Prepare Statement of Approval of Concrete Supplier stating project name, name of concrete supplier, along with the statement of approval and the signatures of the Contractor and concrete pavement subcontractor. Submit statement as specified in Submittals paragraph above.
- F. Workmanship:
1. When directed by the Owner, remove and replace or repair concrete and related Work which does not conform to specified requirements including strength, tolerances and finishes.
 2. Bear cost of corrections or delays to other work affected by, or resulting from, corrections to concrete Work.
 3. If results of compressive strength tests reveal deficiencies in concrete, meet requirements of ACI 301.
 4. Establish and maintain required lines and elevations.
 5. Check surface areas at intervals necessary to eliminate ponding areas.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Pre installation Meeting: Convene Pre-installation Meeting at Site at least two weeks prior to commencing work of this Section.

1. Require attendance of parties directly affecting work of this Section, including, but not limited to, the following:
 - a. Owner's Representative. (Attendance optional)
 - b. CTL's Representative and Inspector.
 - c. Contractor.
 - d. Concrete sub-contractor.
 - e. Concrete job foreman.
 - f. Concrete supplier.
 - g. Base fine grading contractor.
2. Contact Owner's Construction Manager 30 days prior to pre installation conference to confirm schedule.
3. Review foreseeable methods and procedures related to paving work, including the following:
 - a. CTL's testing and inspection procedures.
 - b. Concrete finishes and finishing.
 - c. Cold- and hot-weather concreting procedures.
 - d. Curing procedures.
 - e. Concrete design mixture and examine procedures for ensuring quality of concrete materials.
 - f. Proposed sources of concrete materials, including capabilities and location of plant that will manufacture concrete.
 - g. Tour, inspect and discuss condition of subgrade, drainage structures, and other preparatory work.
 - h. Requirements for protecting concrete work, including restriction of traffic during installation period and for remainder of construction period.
 - i. Review and finalize construction schedule and verify availability of materials.
 - j. Concrete paving requirements (drawings, specifications and other contract documents).
 - k. Required submittals, both completed and yet to be completed.
 - l. Weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - m. Safety precautions relating to placement of concrete.
4. Record discussions of meeting and decisions and agreements reached. Submit in accordance with the requirements of Submittals paragraph.
5. Changes to Contract Documents from recommendations or discussions at the Pre-installation Meeting shall be approved in writing by Owner's Construction Manager prior to implementation.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened containers with labels identifying contents. Keep containers closed and upright to prevent leakage.
- B. Mark reinforcing, accessories and embedded items for proper identification and placement location.
- C. Store materials, except aggregate, off ground in dry area and in manner to prevent damage. Protect liquid materials from freezing.
- D. Stockpile aggregate in manner to prevent contamination with other materials or with other sizes of aggregates. Conduct tests for determining conformance to requirements at point of batching. Do not use bottom 6" of aggregate piles in contact with ground. Allow sand to drain until it has reached a uniform moisture content before it is used.
- E. Store admixtures in manner to prevent contamination. Protect admixtures from extreme temperatures which would adversely affect their characteristics.

1.8 PROJECT CONDITIONS

- A. Hot and cold weather concreting shall be in accordance with ACI 305.1 (hot weather) and 306.1 (cold weather).
- B. Concreting in Hot, Dry, or Windy Weather:
 1. Determine rate of evaporation in accordance with ACI 305.1.
 2. Employ precautions as required to protect fresh concrete before and during finishing when the concrete rate of evaporation exceeds 0.1 pounds per square foot per hour or when any combination of concrete materials and weather conditions are favorable for the formation of plastic shrinkage cracks.

- a. Cool ingredients before mixing to reduce concrete temperature at time of placement. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
 - b. Dampen subgrade and forms.
 - c. Cover reinforcing steel with water soaked burlap so the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Maintain an accurate reading thermometer at the Site to check temperature of concrete.
 4. Temperature of concrete at time of placing: Not to exceed 95 degrees F.
 5. Reject concrete if more than one slump adjustment, as defined in ASTM C 94, is required.
 6. Do not place concrete when forms, subgrade, aggregate base, or reinforcing bars are more than 120 degrees F or the temperature differential between the forms, aggregate base, or reinforcing bars and concrete will create conditions favorable for settlement cracks or thermal cracking.
 7. When high temperature and placing conditions dictate, the concrete supplier may request use of water-reducing retarding admixture (Type D) in lieu of water-reducing admixture (Type A), subject to approval from the Owner's Construction Manager.

C. Concreting in Cold Weather:

1. Thaw subgrade to depth of 12 inches immediately before placing concrete.
2. Measure and record concrete temperature during protection period in each placement at regular time intervals, but not less than 3 times per 24 hour period.
3. Minimum temperature requirements for concrete delivered to Site:
 - a. Air Temperature 30 to 45 degrees F: Concrete temperature 60 degrees F minimum.
 - b. Air Temperature 0 to 30 degrees F: Concrete temperature 65 degrees F minimum.
 - c. Air Temperature below 0 degrees F: Concrete temperature 70 degrees F minimum.
 - d. Maximum concrete temperature: Not to exceed the minimum required temperature by more than 10 degrees F.
4. Do not place slabs on subgrade or base that is more than 20 degrees F cooler than concrete. Warm subgrade or base to decrease temperature differential to 20 degrees F or less
5. When temperatures of 40 degrees F or lower occur during the placing and curing of concrete, maintain temperature of concrete at not less than 50 degrees F for at least 7 days for conventional concrete or at least 3 days for high early strength concrete.
 - a. Make arrangements before placement to maintain required temperature without damage from excessive heat.
 - b. Do not use combustion heaters during first 48 hours without precautions to prevent exposure of concrete to exhaust gases containing carbon dioxide and carbon monoxide.
 - c. Provide temporary housings or coverings including tarpaulins or plastic film. Keep protection in place and intact at least 24 hours after artificial heat is discontinued. Avoid rapid drying of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
6. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306R and 306.1 and as specified in this Section.
7. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Verify that forms, reinforcing steel, and adjacent concrete surfaces are free of frost, snow, and ice and that temperature of these materials is above 32 degrees F before placing concrete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with project requirements, provide products as manufactured by the following to the extent as specified hereinafter for the specific product:
1. American Colloid Company, (800) 527-9948.
 2. [Ardex Engineered Concrete](#), Aliquippa, PA (888) 512-7339. Contact: Linda Zigman.
 3. A.W. Cook Cement Products, (706) 654-3677.
 4. [BASF Admixture Systems](#), Cleveland, OH (800) 628-9990.
 5. [BASF Building Systems](#), Shakopee, MN (800) 433-9517 or (952) 496-6000.
 6. [Chase Construction Products](#), Bridgewater, MA (781) 332-0764.

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7. [ChemTec International, Inc.](#), Cincinnati, OH (513) 474-2090. Contact: James Sist.
8. [Colloid Environmental Technologies Co. \(CETCO\)](#), Hoffman Estates, IL (800) 527-9948.
9. Conspec Marketing & Manufacturing, (800) 348-7351.
10. CTS Cement Manufacturing Corp., (800) 929-3030.
11. [Dayton Superior/Conspec](#), Dayton, OH (888) 977-9600
12. DRC Inc., Carrollton, KY (502) 732-1001.
13. E-Poxy Engineered Materials, (800) 833-3400.
14. [Euclid Chemical Co.](#), Cleveland, OH (800) 321-7628.
15. [GCP Applied Technologies](#) (formerly GCP Applied Technologies and Co.), (713) 223-8353.
16. [Henry Company \(Synko-Flex Products Division\)](#) (800) 231-4551.
17. Permagile Industries, Inc., (800) 645-7546.
18. Reef Industries, (800) 231-6074.
19. [Sika Corp.](#), (800) 933-7452.
20. [Unitex](#), Kansas City, MO (816) 231-7700 or (800) 821-5846.
21. W.R. Meadows, Inc., (800) 342-5976.
22. [Vexcon Chemicals, Inc.](#), Philadelphia, PA (888) 839-2661.

B. Substitutions: Comply with the requirements of Section 01600 unless specified otherwise in this Section.

2.2 EXTERIOR PAVEMENT AGGREGATE BASE MATERIALS

A. Exterior pavement areas shown on the Drawings referencing the “Foundation Subsurface Preparation” for base preparation shall receive aggregate base materials as specified herein unless otherwise shown on the Foundation Subsurface Preparation.

B. Aggregate Base: Use one of the following gradations:

1. Any state DOT approved road base material meeting the following gradation:
 - 1)

Standard Sieve Size	% Passing
No. 1-1/2	100
No. 4	15-55
No. 200	5-12

2. Material conforming to the General Requirements and of the Gradation “A”, ”C”, or “D” requirements (with the modified allowance of 5% to 12% passing the No. 200 sieve) as defined by ASTM D 1241.
3. Material passing the No. 200 shall be clean granular fill with less than 3% clay and/or friable particles.

C. Aggregate Choker Course: Clean granular fill with less than 3% clay and/or friable particles. Use one of the following gradations:

1. ASTM D 448 No. 10 with 6% to 12% passing No. 200 sieve.
2. Material that meets the following gradation:
- 3.

Standard Sieve Size	% Passing
No. 4	85-100
No. 8	75-95
No. 16	55-75
No. 50	22-45
No. 100	10-30
No. 200	6-12

D. Refer to Section 02715 for base materials not subject to the Foundation Subsurface Preparation requirements.

2.3 FORMWORK

- A. Forms: Design, engineer, and construct forms, shores, bracing, and other temporary supports to support loads imposed during construction in accordance with ACI 347. Design under the direct supervision of a licensed Professional Engineer experienced in design of this Work.
 - 1. Plywood: APA Plyform Class 1, complying with DOC PS 1, exterior-grade plywood panels, suitable for concrete forms, 5/8 inch minimum thickness unless otherwise shown or specified, and as follows.
 - a. Plywood for concrete surfaces to be exposed after construction is complete: APA HDO plyform (High Density Overlay) with straight, sealed edges.
 - b. Plywood for concrete surfaces not to be exposed after construction is complete: APA B-B Plyform .
 - 2. Lumber: Dressed, tongue and grooved, free from loose knots.
 - 3. Metal: Smooth, clean, corrosion-free, without dents or holes and with closely-matching edges.
 - 4. Fiberglass: Smooth, clean, without dents or holes and with closely-matching edges.
 - 5. Laminated Round Fiber Tubes: Spirally laminated paper fiber, wax impregnated on exterior surfaces and interior ply allowing uniform moisture penetration.
- B. Form Release Agents:
 - 1. 100% biodegradable, non-toxic, 100% natural organic chemical release agent that will not cause surface imperfections, and is non-staining and compatible with field applied paints, toppings, curing compounds and other coatings.
 - 2. Use same brand form release agent for all forms.
 - 3. Products:
 - a. [Clean Strip J1EF](#) by Dayton Superior.
 - b. [Star Seal EF V Release](#) by Vexcon.
 - c. [Farm Fresh](#) by Unitex.
 - d. [BioStrip WB](#) by SpecChem.
- C. Ties and Accessories:
 - 1. Provide form ties, anchors, and hangers of sufficient strength to resist displacement of forms due to construction loads and depositing of concrete.
 - 2. Provide ties and spreader form ties designed so no metal will be within 1 inch of surface when forms are removed.
 - 3. Where concrete surfaces are exposed to view, use form ties that will leave a depression not more than 1 inch in diameter when removed.
- D. Waterstops: Provide one of the following.
 - 1. [Volclay Waterstop RX-101](#) Bentonite Waterstop by CETCO (Colloid Environmental Technologies Co.).
 - 2. [SF302-Synko-Flex Waterstop](#) by Henry Co.

2.4 REINFORCEMENT

- A. Reinforcing Bars:
 - 1. ASTM A615, deformed, Grade 60.
 - 2. ASTM A706, deformed, Grade 60.
- B. Joint Dowel Bars: ASTM A 615, Grade 40 minimum, or ASTM A36, smooth round plain-steel bars, cut bars true to length with ends square and free of burrs. Epoxy coat per State Highway Department Standard Specifications.
- C. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets.

2.5 REINFORCEMENT ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Reinforcing Support Devices:
 - 1. Manufacturer support devices of metal (wire bar), concrete, or recycled plastic devices conforming to CRSI Manual of Standard Practice.
 - 2. Plastic accessories shall have a minimum of 50% recycled content.
 - 3. Do not use wood, brick and other devices that can expand due to moisture gain.

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4. Precast concrete chairs shall have minimum compressive strength of 3,500 psi.
5. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
6. When precast concrete bar supports are used over aggregate base, or over waterproof membranes and vapor retarders, properly embed tie wires to prevent penetration of substrate.
7. Properly size foot of bar supports or similar devices to prevent settlement on base material or prevent puncture on vapor barrier.
8. When supporting multiple layers of reinforcement, provide the proper size and spacing of bar supports or similar devices to prevent deformation of plastic and to retain rebar within position tolerances.

2.6 CONCRETE MATERIALS

- A. Cement: ASTM C 150 – If reactive aggregates are present in the area, use low alkali cement containing less than 0.6 percent alkalis. Use only one brand throughout project.
1. Required Cement Type based on ACI Exposure Category and Class as noted on Drawings.
 - a. Sulfate Exposure Class S0 – Type I, II, or III.
 - b. Sulfate Exposure Class S1 – Type II or Type III with C₃A content less than 8%.
 - c. Sulfate Exposure Class S2 – Type V or Type III with C₃A content less than 5%.
 - d. Sulfate Exposure Class S3 – Type V plus pozzolan or slag cement.
- B. Concrete Aggregate:
1. Conform to ASTM C33.
 2. Aggregate shall contain no coal or lignite in concrete that will not be covered by soil.
 3. Fine Aggregate:
 - a. Conform to fine aggregate grading requirements as defined in section 6.1 of ASTM C 33 unless approved by the Structural Engineer.
 - b. If manufactured sand is used, blend with minimum 25% natural sand unless otherwise approved by the Structural Engineer.
 4. Coarse Aggregate:
 - a) Nominal maximum coarse aggregate size shall be 1 inch.
 - b) The nominal maximum size of an aggregate is the smallest sieve size through which the major portion of the aggregate must pass, with a minimal amount retained on the maximum sieve size. Maximum 4% shall be retained on the nominal maximum size sieve.
 5. Exterior Slabs: Adjust proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution characteristics, unless otherwise approved:
 - a. Coarseness Factor of 60 to 75%.
 - 1) The Coarseness Factor (CF) is the percent of combined aggregate retained on the #8 sieve that is also retained on the 3/8" sieve.
 - 2) The Coarseness Factor is calculated as follows:
 - 3) $CF = \text{Aggregate retained on } 3/8'' \text{ sieve} / \text{Aggregate retained on } \#8 \text{ sieve.}$
 - b. Adjusted Workability Factor
 - 1) The Workability Factor (WF) is the percent of combined aggregate that passes the #8 sieve.
 - 2) The Adjusted Workability Factor (Adj-WF) is calculated as follows:
 - 3) $\text{Adj-WF} = WF + [(\text{Cementitious Material} - 564 \text{ lbs}) / 37.6]$
 - 4) The range of accepted Adj-WF for a given CF is as follows:
 - 5) $\text{Adj-WF} = [(11.25 - .15 \text{ CF}) + 36] \pm 2.5$
 - 6) Combined percent retained on any given sieve size shall not exceed 24%.
 - c. Gradation requirement of ASTM C33 may be waived in order to meet ranges specified.
- C. Fly Ash: ASTM C618, Type C or F. Use only one type and source throughout the project.
- D. Slag: ASTM C989, Grade 100 or 120. Use only one type and source throughout the project.
- E. Water: Clean potable water, not detrimental to concrete.

2.7 CHEMICAL ADMIXTURES

- A. Air Entrainment: ASTM C 260.
 - 1. [Air-Mix](#) or [AEA-92](#) by Euclid.
 - 2. [MasterAir VR 10](#), [MasterAir AE 90](#), or [MasterAir AE 200](#) by BASF Admixtures.
 - 3. [Daravair or Darex Series](#) by GCP Applied Technologies.
 - 4. [Sika Air Series or AEA Series](#) by Sika.
 - 5. Equivalent approved products.

- B. Water Reducing Admixture: ASTM C494, Type A.
 - 1. Eucon or Plastol Series by Euclid.
 - 2. [MasterPozzolith](#), [MasterPolyheed](#), or [MasterGlenium](#) Series by BASF Admixtures.
 - 3. WRDA, Daracem, Mira-59, Zyla or Adva Series by GCP Applied Technologies.
 - 4. Plastiment, Plastocrete, or Sikament Series by Sika Corp.
 - 5. Equivalent approved products.

- C. Water Reducing and Retarding Admixture: ASTM C494, Type B or D.
 - 1. [Eucon Retarder 75](#) by Euclid.
 - 2. [MasterPozzolith](#) or [MasterSet DELVO](#) Series by BASF Admixtures.
 - 3. [Recover](#), [ZYLA-R](#), or [Daratard 17](#) by GCP Applied Technologies.
 - 4. [Plastiment or Plastocrete Series](#) by Sika Corp.
 - 5. Equivalent approved products.

- D. Accelerating Admixture: ASTM C494, Type C or E.
 - 1. [Accelguard 80](#) by Euclid.
 - 2. Daraset Series, Daracel, Lubricon, Polarset, or DCI by GCP Applied Technologies.
 - 3. [MasterSet](#) Series by BASF Admixtures.
 - 4. [Plastocrete 161 FL](#), [Plastocrete 161 HE](#), [Sikaset NC](#), or [Sikaset HE](#) by Sika Corp.
 - 5. Calcium Chloride (Type L) in solution form.
 - 6. Equivalent approved products.

- E. Evaporation Retardant: Water-based polymer, sprayable.
 - 1. [EucoBar](#) by Euclid.
 - 2. [MasterKure ER 50](#) by BASF Admixtures.
 - 3. Conspec [Aquafilm](#) by Dayton Superior.

- F. High-Range Water Reducing Admixture: ASTM C 494, Type F or G.
 - 1. Type F:
 - a. [Eucon 37](#) by Euclid.
 - b. [Daracem 100](#) by GCP Applied Technologies.
 - c. [MasterRheobuild 1000](#) or [MasterGlenium Series](#) by BASF Admixtures.
 - d. [ViscoCrete](#), [Sikament](#), or [Sikaplast](#) by Sika.
 - e. Equivalent approved products.
 - 2. Type G:
 - a. [Eucon 537](#), by Euclid.
 - b. [Daracem 100](#) by GCP Applied Technologies.
 - c. Equivalent approved products.

- G. Other Admixtures: Additional admixtures including retarding, accelerating, and evaporation retardant are specified in Section 03314.

2.8 RELATED MATERIALS

- A. Joint Materials: Specified in Section 07900.
- B. Foundation Perimeter Insulation: Specified in Section 07210.
- C. Epoxy Bonding Agent: ASTM C881
 - 1. [Euco #452](#) by Euclid.

2. [EVA-POX Epoxy Paste No. 22](#) by Chase Construction Products.
3. [MasterEmaco ADH 326](#) by BASF Building Systems.
4. [Sikadur 32 Hi-Mod LPL](#) by Sika.

D. Patching Mortar:

1. FDM by Ardex for vertical or horizontal placement, formed and poured.
2. B20 by Ardex for vertical or overhead placement, hand packed.
3. ERM by Ardex for exterior horizontal applications.
4. Approved equivalent products.

E. Bond Breaker: ASTM D226, No. 15, unperforated asphalt saturated felt.

F. Leveling Compound:

1. Ardex V-1200, by Ardex. Contact: Linda Zigman.
2. Flo-Top or Super Flo-Top, by Euclid.
3. SikaTop Overlay System, by Sika.
4. Thoro Underlayment Self-Leveling including Thoro Primer #800, by Thoro.
5. Certi-Vex SLU TC including EnvioBond A Primer, by Vexcon.
6. Conflow including Primeflow, by Conspec.
7. MASTERTOP 110 UNDERLAYMENT, by Master Builders.

G. Concrete Sealer for Imprinted Concrete Areas: Provide the following:

1. Solvent based concrete sealer having a minimum 25% solids: High Solids Clear Seal by Increte Systems Inc. or equivalent.
2. Solvent based concrete sealer low VOC (<100 g/L): Clear Seal-100 by Increte Systems, Inc.

2.9 CONCRETE CURING MATERIALS

A. Water: Clean, clear, and potable, not detrimental to concrete finish.

B. Concrete Curing Cover:

1. AquaCure, by DRC.
 - a. Exclusive Distributor: Greenstreak Group, Inc., St. Louis, MO (800) 325-9504.
2. Ultracure by McTech Group.

C. Liquid Membrane Curing and Sealing Compound: ASTM C 1315, Type I, Class A or B, 25% minimum solids content, clear non-yellowing with no styrene-butadiene.

1. Water Based, VOC less than 350 g/l:
 - a. [Super Aqua Cure](#) by Euclid Chemical Corp.
 - b. [MasterKure CC 1315WB](#) by BASF Building Systems.
2. Solvent Based:
 - a. [Super Rez-Seal](#) by Euclid Chemical Corp.
 - b. [MasterKure CC 300 SB](#) by BASF Building Systems.

D. Dissipating Curing Compound: ASTM C 309 Type 1, Class A or B, solvent or water base, VOC less than 350 g/l.

1. [Certi-Vex EnvioCure 100](#) by Vexcon. (Solvent base).
2. [Day Chem REZ Cure \(J-11-W\)](#) or [Safe Cure & Seal \(J19\)](#) by Dayton Superior. (Water Base).
3. [Kurez DR VOX](#), by Euclid. (Water Base).

2.10 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94. Prepare design mixes for each type and strength of concrete by the laboratory trial batch or the field experience method as specified in ACI 301.

B. ACI Exposure Category and Class: ACI freeze/thaw and sulfate exposure category and class shall be as indicated on Drawings. Exposure class with highest compressive strength and lowest maximum water cementitious material ratio shall take precedence for each mix.

- C. Structural Concrete Footings:
1. Compressive Strength: Strength at 28 days shall be as follows unless otherwise indicated on the Drawings:
 - a. Exposure Class F0, F2, F3, or S0: 3,000 psi
 - b. Exposure Class S1: 4,000 psi
 - c. Exposure Class S2 or S3: 4,500 psi
 2. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag):
 - a. Exposure Class F0, F2, F3, S0 or S1: 0.50 by wt.
 - b. Exposure Class S2 or S3: 0.45 by wt.
 3. Slump: Slump at the point of placement shall not exceed 5 inches and shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding. Maximum slump variance shall be 2 inches.
 4. Air Content: Do not air-entrain unless required for concrete workability. Not to exceed 5.0 percent.
- D. Structural Concrete Formed Walls:
1. Compressive Strength: Strength at 28 days shall be as follows unless otherwise indicated on the Drawings:
 - a. Exposure Class F0 or S0: 3,500 psi
 - b. Exposure Class S1: 4,000 psi
 - c. Exposure Class F2, S2 or S3: 4,500 psi
 - d. Exposure Class F3: 5,000 psi
 2. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag):
 - a. Exposure Class F0, S0 or S1: 0.50 by wt.
 - b. Exposure Class F2, S2 or S3: 0.45 by wt.
 - c. Exposure Class F3: 0.40 by wt.
 3. Slump: Slump at the point of placement shall not exceed 5 inches and shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding. Maximum slump variance shall be 2 inches.
 4. Air Content: As specified in the Table below.
- E. Non-Structural Exterior Concrete Pavement and Slabs on Grade:
1. Compressive Strength: Strength at 28 days shall be as follows unless otherwise indicated on the Drawings:
 - a. Exposure Class F0 or S0: 3,500 psi
 - b. Exposure Class S1: 4,000 psi
 - c. Exposure Class F2, F3, S2 or S3: 4,500 psi
 2. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag):
 - a. Exposure Class F0, S0 or S1: 0.50 by wt.
 - b. Exposure Class F2, F3, S2 or S3: 0.45 by wt.
 3. Slump Range: 2"- 4" for hand placed concrete, 1-1/4" to 3" for machine placed (slipform) concrete. Maximum slump variance shall be 2 inches.
 4. Air Content: As specified in the table below.
- F. Non-Structural Interior Concrete Curbs and Equipment Pads:
1. ACI Exposure Class: All Classes.
 2. Compressive Strength: Strength at 28 days shall be 3500 psi unless otherwise shown or specified.
 3. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag): 0.55 by wt.
 4. Slump: Slump at the point of placement shall not exceed 5 inches subject to the requirement that concrete shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding. Maximum slump variance shall be 2 inches.
 5. Air Content: Do not air-entrain interior concrete.
- G. Other Structural Concrete (Applies to concrete structures not listed in sections above):
1. Where concrete is not in contact with soil, backfill or base material, the sulfate exposure requirement can be disregarded.
 2. Compressive Strength: Strength at 28 days shall be as follows unless otherwise indicated on the Drawings:
 - a. For Concrete Not Exposed to Weather: Min 3,500 psi
 - 1) Exposure Class S0: 3,500 psi
 - 2) Exposure Class S1: 4,000 psi
 - 3) Exposure Class S2 or S3: 4,500 psi

- b. For Concrete Exposed to Weather:
 - 1) Exposure Class F0 or S0: 3,500 psi
 - 2) Exposure Class S1: 4,000 psi
 - 3) Exposure Class F2, S2 or S3: 4,500 psi
- 3. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag):
 - a. For Concrete Not Exposed to Weather: Min 0.50 by wt.
 - 1) Exposure Class S0 or S1: 0.50 by wt.
 - 2) Exposure Class S2 or S3: 0.45 by wt.
 - b. For Concrete Exposed to Weather:
 - 1) Exposure Class F0, S0 or S1: 0.50 by wt.
 - 2) Exposure Class F2, S2 or S3: 0.45 by wt.
 - 3) Exposure Class F3: 0.40 by wt.
- 4. Slump: Slump at the point of placement shall not exceed 5 inches subject to the requirement that concrete shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding. Maximum slump variance shall be 2 inches.
- 5. Air Content:
 - a. For Concrete Not Exposed to Weather: Not to exceed 5.0 percent.
 - b. For Concrete Exposed to Weather: As specified in the Table below plus or minus 1.5 percent.

H. Concrete Mix Air Entrainment: Where an exterior concrete mix is noted to be air entrained, the air entrainment shall be as follows:

Nominal Maximum Size Aggregate (Inch)	Average Air Content (%) +/- 1.5% By Exposure Class	
	Class F0	Class F2 & F3
3/8	4.5	7.5
1/2	4.0	7.0
3/4	3.5	6.0
1	3.0	6.0
1-1/2	2.5	5.5

- I. Concrete to be Placed by Pumping Methods:
 - a. The minimum quantity of constituent materials passing the No. 50 sieve (fine aggregate and cementitious materials) shall be 600 pounds per cubic yard.
 - b. The particle size distribution of the combined fine and coarse aggregate shall be uniform from the largest to the smallest particles.
- J. Admixtures:
 - 1. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability. Unless otherwise permitted herein, chemical admixtures shall be dispensed at the batch plant. Use high-range water-reducing admixture (HRWR) in pumped concrete.
 - 2. Use air-entraining admixture in exterior concrete exposed to weather. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content specified above.
 - 3. Use admixtures for water reduction and set control (accelerators and retarders) in strict compliance with manufacturer's directions.
 - 4. Verify with the admixture manufacturer the following:
 - a. The compatibility of the individual admixtures when combined in the concrete mix.
 - b. The compatibility of the individual admixtures with the concrete materials.
- K. Supplementary Cementitious Materials (SCM):
 - 1. Concrete mix shall contain SCM at the amounts specified unless other amounts are approved by the Structural Engineering Consultant. Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for the SCM but shall not be used together to form a ternary mix. Use of fly ash or GGBFS in the concrete mix is mandatory.

2. Fly Ash: Substitute fly ash for Portland cement at 20% of the total cementitious content.
 - a. If used to mitigate potential aggregate reactivity, up to 25% fly ash substitution for Portland cement may be used. Only Type F fly ash may be used and shall have the following maximum properties: 1.5% available alkali and 8.0% CaO. When a maximum of 25% replacement is used, up to 10.0% CaO is permitted.
3. Ground Granulated Blast Furnace Slag (GGBFS): Substitute GGBFS for Portland cement at 25% of the total cementitious content.
 - a. If required to mitigate potential sulfate exposure or aggregate reactivity, up to 50% GGBFS substitution for Portland cement may be used.
4. Maintain air-entrainment at specified levels.
5. In cold weather, provide adequate concrete strength gain so concrete will not be damaged from traffic and loads of use.

L. Calcium Chloride Admixture:

1. Calcium chloride (Type L) conforming to ASTM D98 may be used in solution form as part of the mixing water to accelerate concrete setting and early-strength development.
2. Amount of calcium chloride added shall not be more than necessary to produce the desired results and shall not exceed 2% by weight of cement.
3. The dosage range for the calcium chloride for the entire project shall not vary by more than 1%. Range is defined as the difference between the maximum and minimum dosages of calcium chloride for the entire project.
4. Calcium chloride shall not be used in the following applications unless approved by the Structural Engineer:
 - a. Concrete containing embedded dissimilar metals or aluminum
 - b. Exterior concrete slab on grade
 - c. Slabs supported on permanent galvanized steel forms
 - d. Concrete exposed to deicing chemicals
 - e. Prestressed or post-tension concrete
 - f. Concrete containing aggregates with potentially deleterious reactivity and concrete exposed to soil
 - g. Concrete exposed to soil or water containing sulfates.
5. Use calcium chloride in accordance with manufacturer's recommendation.
6. Chloride-ion Concentration: Maximum water-soluble chloride-ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious material, and admixtures shall not exceed the following limits unless approved by the Structural Engineer:

Type of Member	Maximum water-soluble chloride ion (Cl-) content in concrete (percent by weight of cement)
Prestressed Concrete	.06
Reinforced concrete exposed to chloride in service	.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	.30

7. When using calcium chloride or other admixtures containing chlorides, measure water-soluble chloride-ion content (percent by weight of cementitious materials) per ASTM C 1218. Sample shall be from concrete representing the submitted mix design and maximum chloride dosage anticipated for the project.

2.11 MIXING

A. Ready-Mixed Concrete:

1. Mix and transport in accordance with ASTM C 94 and ACI 301 except as specified.
2. Reset drum revolution counter to zero on ready mix concrete truck when water is added to drum.

B. Site-Mixed Concrete:

03310-15

1. Conform to ACI 301.
 2. Use central-mix type batch plant.
- C. Proportion concrete materials on basis of field experience or by laboratory trial batches.
- D. Ready-mix concrete supplier may proportion materials by field experience.
- E. Proportioning by Water-Cement ratio is not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Use proper dust control methods. Apply bonding agent in accordance with manufacturer's instructions.
- B. Preplacement Inspection: All trades and participants involved shall verify that preparations are in conformance with Contract documents. Inspect reinforcement, inserts, and embedded parts before beginning concrete placement to ensure accurate size and location. Use approved sign-off forms.
- C. Notify Owner Testing Laboratory minimum 48 hours prior to commencement of concreting operations
- D. Cleaning Equipment: Remove hardened concrete and foreign materials from mixing and conveying equipment.
- E. Ensure that all work is properly coordinated:
 1. Structural Drawings and Specifications with those of other disciplines.
 2. Use final corrected Shop Drawings, placing Drawings and material / equipment Drawings

3.3 INSTALLATION - GENERAL

- A. Establish and maintain required lines and elevations.
- B. Check surface areas at intervals necessary to eliminate ponding areas.

3.4 AGGREGATE BASE PLACEMENT

- A. Where exterior pavement areas are shown on the drawings referencing the "Foundation Subsurface Preparation" for base preparation, place aggregate base in accordance with requirements herein.
- B. Aggregate Base:
 1. Install aggregate base where shown on Drawings.
 2. Compact to final thickness shown in layers not exceeding 6 inches with minimum of 2 passes per layer with vibratory compactor.
 3. Compact fill to 98% of aggregate's Standard Proctor as determined by Method D of ASTM D698.
 4. Leave pad up to 2 inches low until just prior to concrete placement.
- C. Aggregate Base Fine Grading:
 1. Compact to final thickness noted with 2 passes minimum vibratory compactor to produce smooth, flat, dense surface.
 2. Aggregate choaker coarse or top 2" DOT approved road base shall be place dry immediately before placing concrete.
 3. Do not allow excess moisture or soft soil beneath vapor retarder at time of placing concrete.

4. Thickness shall not exceed 2 inches.
 5. Level off aggregate base top surface with aggregate chocker coarse material as necessary as follows:
 - a. to reduce surface friction and to meet specified fine grade tolerances specified below. Typically required up to 3/4" thick in areas exposed to rain, traffic, or excavation for pits and buried utilities.
 - b. where aggregate base material does not have sufficient fine particles to produce a surface that is free of exposed aggregate or surface voids greater than 3/8" in size at time of slab installation.
 6. Use laser guided equipment used to establish specified base elevation.
 7. Provide dry, smooth, flat, dense surface
 8. Proofroll 48 hrs maximum prior to concrete placement. Depression under a fully loaded ready mix truck shall not exceed 1/2 inch.
- D. Pavement Aggregate Base Fine Grade Tolerance: +0 inch, -3/4 inch with transition no greater than 3/4 inch vertically to 8 inches horizontally for level slab.

3.5 FORMWORK

- A. Form vertical surfaces of concrete work.
- B. Design, construct, erect, support, and remove formwork and related items in accordance with most stringent requirements of ACI 117, 301, 304R, and 347R
 1. Camber forms to allow for deflection due to weight of fresh concrete.
- C. Formwork for concrete surfaces to be painted or exposed to view after completion of project shall conform to the following:
 1. Do not use forms with dents, holes or patches.
 2. Individual formwork elements shall be as large as possible.
 3. Position individual formwork elements in regular, uniform pattern with joints aligned.
 4. Uniformly space and align form ties in horizontal and vertical rows.
 5. Construct forms for removal without hammering or prying against concrete.
 6. Temporary formwork openings (for cleaning, inspecting, etc) shall be placed on unexposed side or constructed so that concrete surface at opening will match adjacent concrete in appearance.
- D. Form Preparation
 1. Clean formwork.
 2. Remove rust from steel formwork.
- E. Erecting Forms:
 1. Solidly butt joints and provide backup at joints as required to prevent leakage of cement paste.
 2. Do not tape formwork joints.
 3. Just before placing concrete, clean forms and adjacent surfaces again as necessary. Remove wood, sawdust, chips dirt and other debris.
 4. If necessary to grease tie threads, do not allow grease to contact remainder of tie when wall will be exposed to hydrostatic pressure.
- F. Form Release Agent
 1. Before placing reinforcing steel, thoroughly coat contact surfaces of forms with an approved form release agent.
 2. Apply form release agent evenly without excess drip.
 3. Do not allow form release agent to come into contact with concrete surfaces against which fresh concrete will be placed.
 4. Moisten wood forms immediately before placing concrete where form release agents are not used.
- G. Form Construction for Paving:
 1. Set forms to required grades and lines, rigidly braced and secured.
 2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
 3. Check completed formwork for grade and alignment to following tolerances:

- a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

3.6 PLACING REINFORCEMENT

- A. Place reinforcing in accordance with most stringent requirements of ACI 117, 301 and 308 and CRSI Manual of Standard Practice and Placing Reinforcing Bars.
- B. Accurately place and secure reinforcement against displacement by firmly wiring at intersections and splices with not less than No. 18 U.S. Standard Gauge annealed wire.
- C. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, Documents 63 and 65. Detailing practices and fabrication shall conform to ACI SP66.
 - 1. Place and secure saddle ties at every other intersection with wire; hold in place with metal chairs or spacers during placing of concrete.
 - 2. Hold bars in beams and slabs to exact location during concrete placement. Use spacers, chairs, or other necessary supports with the following tolerances:
 - a. Bars in Slabs and Beams:
 - 1) Members 8 Inches Deep or Less: $\pm 1/4$ inch.
 - 2) Members 8 Inches to 2 Feet Deep: $\pm 1/2$ inch.
 - 3) Members more than 2 Feet Deep: ± 1 inch.
 - b. Lengthwise of Member: ± 2 inches.
 - c. Concrete Cover to Formed Surfaces: $\pm 1/4$ inch.
 - d. Minimum Spacing Between Bars: $\pm 1/4$ inch.
- D. Turn wire ends away from concrete exterior.
- E. Ensure reinforcing is clean, free from defects and kinks, loose mill or rust scale or coatings that will reduce bond.
- F. Protect exposed reinforcing bars, inserts and plates intended for bonding with future expansion from corrosion.
- G. When welding of reinforcement is specified, comply with AWS D1.4. Do not tack weld crossing bars for assembly of reinforcement, supports or embedded items.
- H. Exterior Slab on Ground and Pavement Dowels:
 - 1. Install round smooth dowels within $\pm 1/4$ inch alignment in vertical and horizontal planes.
 - 2. Secure dowels and sleeves perpendicular to joint and parallel to finished concrete surface.
 - 3. Use prefabricated dowel supports at ends of dowels to maintain alignment.
 - 4. Dowel alignment shall be within specified tolerances.
 - 5. Lightly grease round smooth dowels to prevent bond to concrete.
 - 6. Do not grease plate dowels.

3.7 EMBEDMENTS

- A. Install anchor bolts and embedded bearing devices provided by others.
- B. Provide other anchor bolts and bearing devices shown on Drawings or anchor bolt setting plans or required equipment installation.
- C. Use templates as required for spacing between anchor bolts and set elevations with surveying equipment.
- D. Position and anchor steel shapes, anchor bolts, casings, conduit sleeves, masonry anchorages and other materials embedded in concrete.

- E. Place and secure against displacement miscellaneous steel, pipe sleeves, inserts, anchors, stair abrasive nosings, preformed joint fillers, vapor retarders and miscellaneous embedded items.
- F. Secure embedments to formwork when possible.
- G. Install clean embedments. After concrete placement, clean embedment exposed surfaces of concrete splatter and other foreign substances.
- H. Unless noted otherwise on the Drawings, ensure corner protection angles, bars and other similar embedded metal items are continuous between concrete joints. If shorter lengths are required for metal items, connect the ends by butt-welding entire joint and grinding smooth exposed surface. Ensure embedded metal items are discontinued at construction, contraction and isolation joints.
- I. Temporarily fill voids in sleeves and inserts with easily removable materials.
- J. Before placing concrete on grade, piping and other utilities under concrete shall be inspected, tested, and excavations backfilled and properly compacted to solid bearing.
- K. Allow sufficient time between erection of forms and placing concrete for other trades to install and test their work.

3.8 JOINTS

- A. Joints
 - 1. Provide construction, isolation and contraction joints as indicated on Drawings and as noted below.
 - 2. Bulkheads for construction joints shall be 1-1/2 inch minimum lumber. Do not use permanent preformed metal bulkheads.
 - 3. Provide bulkheads full depth of member.
 - 4. Space joints to allow one continuous placement between bulkheads.
 - 5. Unless otherwise shown on the Drawings, do not extend reinforcement, corner protection angles, bars or other fixed metal items through construction joints or contraction joints in slabs on ground or pavements or through joints between slabs on ground and vertical surfaces.
 - 6. Match joints in walls and curbs with joints in slabs on ground and pavements.
 - 7. Extend joints across tops of walls and curbs unless noted otherwise on Drawings.
 - 8. Ensure saws are equipped with HEPA-filtered dust collection vacuum systems as specified herein.
- B. Contraction Joints:
 - 1. Unless otherwise shown on the Drawings, do not extend reinforcement, corner protection angles, bars or other fixed metal items through construction joints or contraction joints in slabs on ground or pavements or through joints between slabs on ground and vertical surfaces.
 - 2. Match joints in walls and curbs with joints in slabs on ground and pavements.
 - 3. Extend joints across tops of walls and curbs unless noted otherwise on Drawings.
- C. Pavement Joint Construction: Construct weakened-plane control (contraction), and construction joints straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline, unless otherwise detailed.
 - 1. Weakened-Plane Control or Contraction Joints: Provide joints at spacing of 12'-0" on centers, maximum each way. Construct control joints for depth equal to at least 1/4 of the concrete thickness, as follows:
 - a. Form tooled joints in fresh concrete by grooving top with recommended tool and finishing edge with jointer.
 - b. Sawed Contraction Joints:
 - 1) Use saws, blades, skid plates, and accessories by Soff-Cut International, Inc., (800) 288-5040, or approved equal.
 - 2) Provide at least two Soff-Cut saws with blades capable of achieving the required depth of saw cut.
 - 3) Start cutting sawed joints as soon as concrete has hardened sufficiently to prevent raveling or dislodging of aggregates. This will typically be from 1 hour in hot weather to 4 hours in cold weather after completing finishing of slab in that joint location.

- 4) Extend sawed joint to the slab boundaries and abutments, including columns, drains, and other penetrations in the path of a defined joint. Implement methods and timing of the saw cut beyond the limits of the Soff-Cut saw reach to provide a consistent depth of cut with minimal raveling of joint edges.
- c. Saw-Cut Control Joint Dust Collection: Connect one of the following dust collection systems directly to each Soff-Cut saw being used. Select collection system model recommended by the manufacturer to maintain dust emissions at the lowest permissible level for the size of the Soff-Cut blade.
 - 1) Pulsevac Dust Collector by E. G. Enterprises
 - 2) ProVac Dust Collection System by [GladTech, Inc.](#), (614) 251-8111.
 - 3) SoffVac by Soff-Cut International, Inc.
2. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour. Construct joints in accordance with details shown.
 - a. Soft Preformed Joint Fillers: Extend preformed joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface. Furnish preformed joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip preformed joint filler sections together in a single plane.
 - b. Joint Sealants: Install joint sealants in accordance with manufacturer's recommendations.
- D. Doweled Joints: Install dowel bars and support assemblies at joints as indicated. Make provision to prevent concrete bonding to one side of joint by methods shown on the drawings.
- E. Joint filling and sealing is specified in Section 07900.

3.9 CONVEYING

- A. Handle concrete from mixer to place of final deposit as rapidly as practicable and in manner which will assure obtaining specified quality of concrete.
- B. Retempering: Discard concrete which has already begun to set. Do not retemper with water.
- C. Equipment: Provide mixing and conveying equipment of proper size and design to ensure a continuous flow of concrete to delivery end. Do not use aluminum pipe or equipment in contact with concrete.
 1. Mixers, agitators and non-agitating units: Conform to ASTM C 94 and current certification requirements of Department of Transportation in state where concrete plant is located.
 2. Belt Conveyers:
 - a. Use only types which will not cause segregation.
 - b. Discharge runs over 30 feet into hopper.
 3. Chutes: Metal or metal lined not to be installed at slopes greater than 1 vertical to 3 horizontal.
 4. Runways:
 - a. Provide runways or other means above finished concrete level for wheeled conveying equipment.
 - b. Do not support runways on reinforcing.
 - c. Do not wheel equipment directly over reinforcing or metal deck.
 5. Pumps:
 - a. Submit to Testing Lab Agency for review, changes to concrete mix to necessitate pumping.
 - b. Use pump hoses and other slickline components with 5 inch minimum inside diameter.
 - c. For slickline reducers, reduction in diameter shall not exceed 1 inch over a 5 foot length.

3.10 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301; including hot and cold weather placement procedures.
- B. Inspect reinforcement, inserts, and embedded parts before beginning concrete placement to verify accurate size and location.
- C. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

- D. Place concrete in uniform layers, horizontal, 12 to 18 inches thick, exercising care to avoid vertical joints or inclined planes. Place concrete continuously between predetermined construction joints shown on structural drawings. Piling up of concrete in forms to cause separation or loss of ingredients is not permitted.
- E. Do not deposit concrete which has partially set or hardened. Do not deposit initial lubricating mortar when pumping concrete. Remove hardened or partially hardened concrete which has accumulated on forms or reinforcement. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause formation of seams or planes of weakness within respective member or section except as specified.
- F. Deposit concrete as nearly in final position as practical to avoid rehandling. Exercise care to prevent splashing forms or reinforcing with concrete. Do not permit concrete to drop freely a distance greater than 3 feet. Where longer drops are necessary, use chute, tremie, or other conveyance to help avoid separation.
- G. Do not deposit concrete into excavation where water is standing. If place of deposit cannot be successfully pumped dry, place through tremie with outlet end near bottom of place of deposit.
- H. Deliver concrete from only one concrete batch for any given days placement. The same concrete plant shall be used for the entire interior slab placements unless approved in writing prior to change
- I. Do not place concrete over standing water, mud, frost, ice or snow.
- J. Do not use wet screeds.
- K. Consolidation:
 1. Consolidate concrete complying with ACI 301 by vibrating, spading or rodding so that concrete is thoroughly worked around reinforcing.
 2. Do not insert vibrator into portions of concrete that have begun to set.
 3. Keep spare vibrator on job site during concrete operations.
 4. Consolidate and screed slabs to allow construction joint pattern as indicated on Structural Drawings and as specified. Consolidate concrete by vibrating laser screeds. Other vibratory screeding methods are acceptable only in areas where laser screed is not accessible.
 - a. Check laser screed level head a minimum of 3 times during each pour. Use feeler gauge to measure deviations. If deviations are present, replace head with a new straight one.
 5. Use internal vibration along construction joints at both formed and slab abutments. Vibrate under plate dowels. Mark forms before concreting to properly locate dowels after concreting.
 6. Do not use grate tampers, jitterbugs, or mesh rollers.
- L. Do not deposit concrete when plasticity, measured by slump test, is outside specified limits. The addition of water to increase slump will not be permitted.
- M. Vibration: As soon as concrete is deposited, thoroughly agitate with mechanical vibrators and suitable hand tools to work mixture into corners of forms and around reinforcing and embedded items. Use mechanical vibrators with minimum frequency of 9000 revolutions/minute. Do not over vibrate or use vibrators to transport concrete within forms. Insert and withdraw vibrators at approximately 18 inches apart. At each insertion, vibrate generally 5-15 seconds, sufficient to consolidate concrete but not long enough to cause segregation. Keep spare vibrator on job site during concrete placement operations. Do not insert vibrator into lower coarses that have begun to set.
- N. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Owner Construction Manager upon discovery.
- O. Pumping: Maintain controls for proportioning, mixing, adjustment of mix, and placement in accordance with ACI 301 and ACI 304.2R

3.11 FINISHING PROCEDURE

- A. Formed Surfaces:
 1. Rough-Form Finish:

- a. Patch tie holes and defects. Clip or rub off fins exceeding 1/2 inch in height. Leave surfaces with texture imparted by forms.
 - b. Apply on concrete surfaces not exposed to public view and where noted on Drawings.
 - 2. Smooth-Form Finish:
 - a. Patch tie holes and defects. Remove fins exceeding 1/8 inch in height.
 - b. Apply on concrete surfaces exposed to public view and where noted on Drawings.
- B. Initial Finishing:
 - 1. Re-straighten surface irregularities with a 10 ft highway screed in two directions as close to perpendicular as possible before water appears on concrete surface.
 - 2. Do no further working of surface until time for floating; do not work surface while water is present.
 - 3. "Dry Sprinkle" method finishing is not acceptable and will be cause for rejection
- C. Floating:
 - 1. Begin float operations when bleed water sheen has disappeared and concrete has stiffened sufficiently to allow walking on surface without leaving heel prints more than 1/4 inch deep. Check and level the surface lane to an initial tolerance not exceeding 1/4 inch in ten feet when tested with a ten foot straight edge. Immediately after leveling, refloat surface to a uniform smooth granular surface. Use magnesium or aluminum power float unless otherwise specified.
 - 2. Avoid premature finishing that brings excessive fines to surface causing finished slab to have soft surface which will dust.
- D. Troweling:
 - 1. Delay troweling as long as possible to prevent working excess fines and water to surface. Do not begin until surface moisture film and shine remaining after floating have disappeared. Trowel in alternate pass directions.
 - 2. Power trowel using riding trowel where possible. Use hand trowel in inaccessible areas.
 - 3. Do not over-trowel floors scheduled to receive curing/sealing compound unless specified otherwise.
 - 4. Do not re-wet surface to trowel.
 - 5. Final hand finish passes shall be done in the same direction. Finish all surfaces within a reasonable time period to provide uniformity of appearance.
- E. Broom Finish:
 - 1. Provide a floated finish, then finish with broom.
 - a. Heavy Broom Finish: Steel wire or stiff, coarse, fiber broom.
 - b. Light Broom Finish: Soft-bristled fiber broom.
 - 2. Allow surface to harden sufficiently to retain scoring or ridges.
 - 3. Broom transverse to traffic or at right angles to slope of slab.
- F. Sealing: Apply concrete sealer where noted on the Architectural drawings.
- G. Finish Schedule:
 - 1. Unexposed Exterior Formed Surfaces: Rough form finish.
 - 2. Exposed Exterior Formed Surfaces: Smooth form finish, stone rubbed.
 - 3. Equipment Pads: Troweled
 - 4. Exterior and Interior Curbs: Troweled
 - 5. Sidewalks: Light broom.
 - 6. Ramps and Steps: Heavy broom.
 - 7. Exposed exterior slabs, unless otherwise noted in this Section or on Drawings: Light Broom Finish.

3.12 CURING

- A. General:
 - 1. Cure concrete in accordance with ACI 301, ACI 308R and ACI 308.1, except as noted.
 - 2. Start curing as soon as concrete surface will not be damaged by curing operations.
 - 3. Continuously cure concrete for at least 7 consecutive days.
 - 4. During curing period, do not allow any part of the concrete to become dry.

5. If using forms for curing, keep forms in contact with concrete wet during curing period unless type of form is impervious to water, such as metal or fiberglass.
6. If forms are removed before curing period is complete, continue curing immediately with other approved methods

B. Methods of Curing:

1. Impervious Sheet Cure: Wet exposed surfaces of concrete after completing finishing and then apply prewetted sheet with edges lapped 6 inches minimum and sealed & secured in such manner as to prevent moisture from escaping from concrete from laps or edges. Remove sheets after a 7 day curing period.
2. Curing Compound:
 - a. Apply liquid curing compounds by spraying or rolling uniformly in a single coat on surfaces immediately following final finishing operation.
 - b. Apply curing compound in accordance with manufacturer's recommendations.
 - c. Do not use liquid curing compound on surface against which additional concrete, other finishing materials, or coatings are to be bonded if their bond will be affected by curing compound.
 - d. Spraying shall be by power sprayer.
 - e. Immediately recoat, at the rate specified above, surfaces subjected to rainfall within 3 hours after compound has been applied or surfaces damaged by subsequent construction operations within the curing period.
 - f. Use solvent based curing compounds when compound is applied below 40 F.
 - g.
3. Curing Schedule:
 - a. Unformed surfaces shall receive an impervious sheet cure or curing compound as appropriate except as follows:
 - b. Use impervious sheet cure for exterior color textured finished surfaces.
 - c. Protect and cure finished concrete paving using curing compound.

3.13 JOINT FILLING AND SEALING

- a. Joint filling and sealing is specified in Section 07900

3.14 FORM REMOVAL

- A. Do not remove forms until concrete has hardened sufficiently to support its own weight and imposed construction loads.
- B. Remove forms in manner to avoid damage to concrete.
- C. Formwork for slabs and pavements, curbs and other parts not supporting vertical load of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations, but in no case sooner than 12 hours.
- D. Remove wood forms from under floors, ramps, steps, and similar places (through temporary openings if necessary) so no material will be left to rot or to be infested by termites.

3.15 TOLERANCES

- A. Conform to requirements of ACI 117 and ACI 301 except as specified herein.
- B. Conform to ACI 117 thickness tolerances for slabs-on-ground.

3.16 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not preclude Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

- B. Contractor shall collect and certify each delivery ticket of concrete. Verify that tickets indicate type of concrete delivered, amount of water added and time at which cement and aggregate were loaded into truck, and time at which concrete was discharged from truck.
- C. Responsibilities and Duties of Contractor Relative to Owner T&I:
 - 1. Notify CTL not less than 3 working days prior to placing concrete to allow time for site visit.
 - 2. Assist CTL in securing field specimens.
 - 3. Provide and maintain for sole use of CTL, facilities for safe storage and proper curing of concrete test cylinders at project site as required by ASTM C 31 and acceptable to CTL.

3.17 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (03310).

3.18 NON-CONFORMING WORK

- A. When directed by Owner, repair concrete and related Work which does not conform to specified requirements including strength, durability, tolerances and finishes. Remove and replace defective concrete if repair cannot be accomplished to the satisfaction of Owner's Construction Manager.
- B. Notify Owner's Construction Manager immediately upon discovery of non-conforming Work. Excessive honeycomb or embedded debris in concrete is not acceptable.
- C. Patching: Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, surface imperfections and holes left by tie rods and bolts down to solid concrete, but in no case, to a depth of not less than one inch. Make edges of cut perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
- D. Work on which tests have failed shall be corrected as directed by Owner's Construction Manager.

3.19 PROTECTION

- A. Protect finished work.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and damage.
- C. Patch or replace damaged portions of concrete.
- D. Protect wet cured or impervious sheet cured surfaces as follows:
 - 1. Barricade concrete surfaces immediately after finishing
 - 2. Do not allow light traffic, except for curing purposes, on concrete surfaces until concrete has attained 1800 psi (approx 3 days).
 - 3. Do not allow heavy traffic on concrete surface until concrete has attained, by test, its design strength as noted on drawings, but not sooner than 9 days after placement.
 - 4. Permit concrete to dry minimum of 2 additional days after curing is completed before removing barricades.
- E. Protect surfaces cured with curing compound as follows:
 - 1. Barricade Concrete surfaces immediately after application of curing compound.
 - 2. Do not allow traffic on concrete surfaces sooner than 3 days after placement.

3.20 CLEANING

- A. Remove forms, equipment, protective coverings, and rubbish resulting from concreting operations. Leave finished concrete surfaces in clean conditions. Use vacuum with HEPA-rated filter to remove loose dirt and mud. Do not dry sweep. Remove mortar and concrete droppings. Wash concrete floors and platforms with soapy water and rinse with clean water.

B. Dispose of construction and universal waste in accordance with the requirements of Section 01351.

END OF SECTION

FULFILLMENT CENTER

CONCRETE MIX DESIGN SUBMITTAL FORM
(Section 03310 – Structural Concrete and Exterior Concrete Slabs)

Date _____

PROJECT TYPE: _____

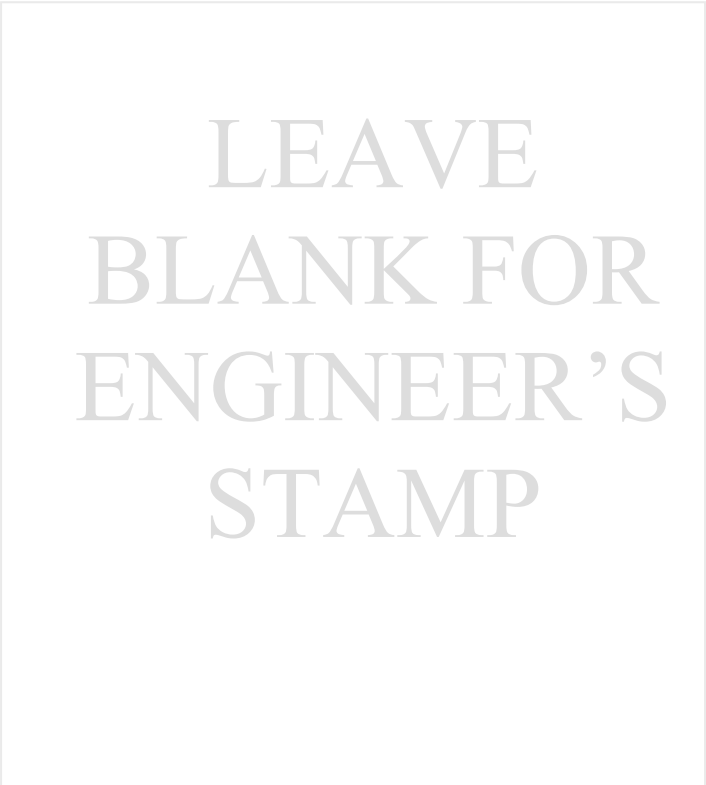
BUILDING INFORMATION

DC # _____
 ADDRESS _____
 CITY, STATE _____
 GENERAL CONTRACTOR
 COMPANY _____
 JOBSITE PHONE _____

A. CONCRETE INFORMATION

Supplier Mix Design #	_____
Design Strength (f'c)	_____ psi
Water / Cementitious Ratio	_____
Total Air Content	_____ %
Total Est. Volume of Concrete	_____ CY
Concrete Uses/Locations	_____

Mix Developed From:	
<input type="checkbox"/>	Trial Mix Test Data (<i>attach test data</i>)
<input type="checkbox"/>	Field Experience
Density	
Wet	_____ pcf Dry _____ pcf
Slump	
_____ "	(± 1") WITHOUT WR Admixture
_____ "	(± 1") WITH WR Admixture



B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces)	
			oz / cy	oz / cwt
Water Reducing				
Accelerating				
Retarding				

C. MIX DESIGN

Mix Proportions (per cubic yard)

	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	Volume (cubic feet)	% Aggregate Absorption
Cement					
Fly Ash					
Slag					
Coarse Aggregate #1					
#2					
#3					
Fine Aggregate #1					
#2					
Water					
Air Content					
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	% Passing Each Sieve (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2		Cumulative	Individual
1-1/2"								
1"								
3/4"								
1/2"								
3/8"								
# 4								
# 8								
# 16								
# 30								
# 50								
# 100								
# 200								
% of Vol								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained } 3/8'' \text{ sieve}}{\text{Combined \% cumulative retained } \#8 \text{ sieve}}$	=	
Workability Factor =	Combined % passing #8 sieve	=	
Adj-Workability Factor =	$WF + [(Cementitious \text{ Material} - 564) \div 37.6]$	=	
Allowable Adj-WF =	$Adj-WF = [(11.25 - .15 \text{ CF}) + 36] \pm 2.5$	=	Low High

D. ATTACHMENTS: Include the following with this Mix Design Report.

- Portland Cement mill test reports
- Fly ash mill test reports where required
- Slag mill test reports
- Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials
- Separate aggregate gradation reports including all required sieve sizes
 - All gradation sieve report tests dated within 60 days of this report
 - Report for each coarse and fine aggregate material in mix
- Statement if possible reactivity of aggregate, based on tests or past service
- Statement if possible aggregate pop-outs or their disruptions, based on tests or past service
- Product data for the following admixtures:
 - Chloride ion data and related calculations
 - Water reducing, set retarding, set accelerating, etc.
- Measured water-soluble chloride ion content in concrete (percent by weight of cement)
- Concrete compressive strength data used for standard deviation calculations

E. CONCRETE SUPPLIER INFORMATION

Company Name _____ **Tel. #** (____) _____

Address _____

City, ST Zip _____

Technical Contact _____ **Cell #** (____) _____

e-mail _____

Sales Contact _____ **Cell #** (____) _____

PRIMARY PLANT

SECONDARY PLANT

Plant Location: _____

Miles from Site: _____

Travel Time to Site: _____

NRMCA Certified: YES NO

YES NO

State DOT Certified: YES NO

YES NO

Batch Mixing Type: DRY CENTRAL MIX

DRY CENTRAL MIX

SECTION 03311 (03 3110) – SITEWORK STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Selected cast-in-place structural concrete for concrete structures related to civil sitework including the following:
 - a. Exterior light pole bases.
 - b. Drainage structures including manholes, inlets, catch basins, collars, support blocks, headwalls and paved ditches.
- B. Related Requirements:
1. Section 02630 – Storm Drainage: Materials and installation of storm drainage structures.
 2. Section 02715 - Base Course: Base for exterior concrete slabs except as otherwise specified herein.
 3. Section 03310 – Structural Concrete and Exterior Concrete Slabs: Materials, quality assurance, and standards publications for concrete, excluding administrative requirements, submittals, and testing.
 4. Appendix B – Testing, Inspection, and Observation by Owner. Testing for concrete light pole bases and CEC site observation requirements for drainage structures.
 5. Section 05500 - Metal Fabrications: Other metal components cast into concrete.
 6. Section 16525 – Site Lighting: Accessories for light pole.

1.2 REFERENCES

- A. The publications listed below and included in Section 03310 form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Mandatory Provisions: In publications referred to herein, advisory provisions shall be considered to be mandatory.
- C. American Association of State Highway and Transportation Officials (AASHTO): Standard Specification For Transportation Materials And Methods Of Sampling and Testing :
1. AASHTO T318 - Water Content of Freshly Mixed Concrete Using Microwave Oven Drying (Formerly AASHTO TP 23)
- D. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI Manual of Standard Practice.
 2. CRSI Placing Reinforcing Bars.
- E. International Code Council, Inc.:
1. International Building Code (IBC).
- F. National Ready Mixed Concrete Association:
1. NRMCA Inspection Standards

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with ACI 301, ACI 318, and CRSI Manual of Standard Practice provisions except where more stringent requirements are shown or specified in Section 03310:

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and Section 03310.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Hot and cold weather concreting shall be in accordance with ACI 305.1 (hot weather) and 306.1 (cold weather) as specified in Section 03310.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to the requirements of Section 03310 for the following materials for concrete in light pole bases and drainage structures:
 - 1. Forms.
 - 2. Aggregate Base and Choker Materials.
 - 3. Reinforcement unless otherwise specified herein.
 - 4. Aggregate Base.
 - 5. Cementitious Materials.
 - 6. Water.
 - 7. Fly Ash.
 - 8. Slag.
 - 9. Air Entrainment.
 - 10. Evaporation Retardant.
 - 11. Bonding agent, patching mortar, and joint materials where required.

2.2 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C 94 and the requirements of Section 03310 for structural concrete for air entrainment, pumping, admixtures, SCM, and calcium chloride.
- B. Drainage structures including manholes, inlets, catch basins, collars, support blocks, headwalls and paved ditches:
 - 1. ACI 301.
 - 2. Compressive Strength: 3500 psi at 28 days.
 - 3. Reinforcement: ASTM A 615, grade 60 deformed reinforcing bars, and ASTM A 185 for wire fabric.
 - 4. Refer to the requirements of Section 03310 for maximum water-cementitious material ratio, slump range, and air content.
- C. Concrete cradles:
 - 1. Compressive Strength: 3000 psi mix with a minimum thickness of 6 inches.
 - 2. Refer to the requirements of Section 03310 for ACI exposure, maximum water-cementitious material ratio, slump range, and air content

2.3 MIXING

- A. Refer to the requirements of Section 03310 for ready-mixed or site-mixed concrete.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.
- B. Pre-placement Inspection: All trades and participants involved shall verify that preparations are in conformance with Contract Documents. Inspect reinforcement, inserts, and embedded parts before beginning concrete placement to ensure accurate size and location. Use approved sign-off forms.
- C. Drainage Structures: Notify CTL minimum 48 hours prior to commencement of concreting operations
- D. Cleaning Equipment: Remove hardened concrete and foreign materials from mixing and conveying equipment.
- E. Ensure that all work is properly coordinated:
 - 1. Drawings and Specifications with those of other disciplines.

3.2 INSTALLATION - GENERAL

- A. Construct cast-in-place drainage structure sections as shown on the drawings and in accordance with Section 03310.
 - 1. Form bottom of excavation clean and smooth to correct elevation.
 - 2. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe to be placed at proper elevation.
 - 3. Form and place cast-in-place concrete walls, sleeved at proper elevation to receive storm sewer pipe in accordance with details shown on Drawings.
- B. Refer to the requirements of Section 03310 for additional form construction and removal, reinforcement, aggregate base, embedments, placement, finishing, and curing.
- C. Check surface areas at intervals necessary to eliminate ponding areas.

3.3 TOLERANCES

- A. Conform to requirements of ACI 117 and ACI 301 except as specified herein.
- B. Conform to ACI 117 thickness tolerances for slabs-on-ground.

3.4 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. Contractor shall collect and certify each delivery ticket of concrete. Verify that tickets indicate type of concrete delivered, amount of water added and time at which cement and aggregate were loaded into truck, and time at which concrete was discharged from truck.
- C. Responsibilities and Duties of Contractor Relative to Owner T&I:
 - 1. Notify CTL not less than 3 working days prior to placing concrete to allow time for site visit.
 - 2. Assist CTL in securing field specimens.
 - 3. Provide and maintain for sole use of CTL, facilities for safe storage and proper curing of concrete test cylinders at project site as required by ASTM C 31 and acceptable to CTL.

3.5 OWNER TESTING AND INSPECTION (T&I)

- A. Owner's testing and inspection (T&I) is specified in Appendix B (03311).
- B. Civil Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

3.6 NON-CONFORMING WORK

- A. Refer to the requirements of Section 03310 for procedures for non-conforming work.

3.7 PROTECTION AND CLEANING

- A. Refer to the requirements of Section 03310 for procedures for protection and cleaning of concrete.

END OF SECTION

SECTION 03314 (03 3014) – INTERIOR CAST-IN-PLACE CONCRETE SLABS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete slabs including the following:
 - a. Interior floor slabs on ground.
 - b. Interior suspended slabs on metal deck.
2. Aggregate base below slab on ground.
3. Slab reinforcement and accessories.

B. Related Requirements:

1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
2. Section 03310 - Structural Concrete and Exterior Concrete Slabs:
 - a. All concrete not included in this Section including structural concrete work and exterior slabs including exterior sidewalks, door stoops, equipment pads.
3. Section 03362 - Burnished Concrete Floor Finishes: Cleaning, application of densifier and burnishing of floor slabs.
4. Section 03363 – Polished Concrete Floor Finishes for Interior Slabs – Requirements for polished floor finish.
5. Section 05120 - Structural Steel: Column anchor bolts.
6. Section 05500 - Metal Fabrications: Metal components cast into concrete.
7. Section 07900 - Joint Sealers: Joint fillers and sealants for floor slabs.
8. Section 09650 - Resilient Flooring:
 - a. Joint subfloor filler for contraction and construction joints concealed by floor finish material.
 - b. Concrete slab moisture & pH testing.
9. Section 09675 - Resinous Flooring:
10. Appendix B – Testing, Inspection, and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 1. Standard Specification For Transportation Materials And Methods Of Sampling and Testing:
 - a. AASHTO T318 - Water Content of Freshly Mixed Concrete Using Microwave Oven Drying (Formerly AASHTO TP 23).
 - b. AASHTO M147 – Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses
- C. American Concrete Institute (ACI):
 1. ACI 117 - Tolerances for Concrete Construction and Materials and Commentary.
 2. ACI 301 - Structural Concrete.
 3. ACI 305.1 - Hot Weather Concreting.
 4. ACI 306.1 - Cold Weather Concreting.
 5. ACI 308.1 - Standard Specification for Curing Concrete.
 6. ACI 347 - Formwork for Concrete.
 7. ACI SP66 - ACI Detailing Manual.
- D. ASTM International (ASTM):
 1. ASTM A 36 - Carbon Structural Steel.
 2. ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. ASTM A 706 - Low-Alloy Steel deformed and Plain Bars for Concrete Reinforcement.

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4. ASTM C 31 - Making and Curing Concrete Test Specimens in the Field.
5. ASTM C 33 - Concrete Aggregates.
6. ASTM C 39 - Concrete Specimens, Compressive Strength of.
7. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
8. ASTM C 94 - Ready-Mixed Concrete.
9. ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
10. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
11. ASTM C 150 - Portland Cement.
12. ASTM C 171 - Sheet Materials for Curing Concrete.
13. ASTM C 172 – Sampling Freshly Mixed Concrete.
14. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
15. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
16. ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance.
17. ASTM C 494 - Chemical Admixtures for Concrete.
18. ASTM C 618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
19. ASTM C 881 - Epoxy-Resin-Base Bonding Systems for Concrete.
20. ASTM C 989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
21. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
22. ASTM C 1218 - Water-Soluble Chloride in Mortar and Concrete.
23. ASTM C 1602 - Mixing Water used in the Production of Hydraulic Cement Concrete.
24. ASTM D 448 - Classification for Sizes of Aggregate for Road and Bridge Construction.
25. ASTM D 698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb (2.49 Kg) Hammer and 12-in (305 mm) Drop.
26. ASTM D 1241 - Materials for Soil-Aggregate Subbase, Base and Surface Courses
27. ASTM E 1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).
28. ASTM E 1643 - Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
29. ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

E. American Welding Society (AWS):

1. AWS D1.4 - Structural Welding Code Reinforcing Steel.

F. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI Manual of Standard Practice.
2. CRSI Placing Reinforcing Bars.

G. National Ready-Mixed Concrete Association:

1. NRMCA Inspection Standards.

H. Occupational Safety and Health Administration (OSHA):

1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

1.4 ADMINSTRATIVE REQUIREMENTS

- A. Pursuant to Article 2.7 of the Construction Contract Between the Owner and Contractor, the Owner has the right to perform construction work and to award separate contracts on the Site.

- B. The construction work and separate contracts on the Site associated with the floor slab construction may include but are not limited to Building Automation System (BAS) cabling, LP cabling, CCTV cabling, HVAC testing and balancing, telecommunications, data cabling, alarms, and refrigeration.

- C. Owner or Separate Contractor Responsibilities: The following provisions are provided as information to Contractor with respect to the responsibilities of the Owner or separate contractors doing work on, or related to, the building floor slab construction. The Owner or separate contractors must:
1. Notify Contractor's superintendent 1 week prior to the start of the work at Site. Provide names and contact phone numbers to Contractor's superintendent.
 2. Coordinate work and schedule activities with floor slab construction to avoid interference and to minimize detrimental effects to floor finish.
 3. Comply with floor protection measures as specified in this Section and as described in Contractor's Concrete Floor Protection Plan.
 4. Damage to concrete floor finish determined by the Owner to be the responsibility of Owner or separate contractor will be repaired in accordance with approved methods, materials, and personnel at the expense of Owner or separate contractor.
- D. Pre-Slab Installation Meeting:
1. Plan, host, and attend Pre-slab Installation Meeting to be conducted at Site by Owner's Concrete Consultant via teleconference.
 2. Schedule meeting between 7 and 14 days prior to first concrete slab placement.
 3. Obtain Pre-slab Installation Meeting agenda from Concrete Consultant (Structural Services, Inc. (SSI), (877) 774-2677.
 4. Require responsible representatives of each party involved with the interior concrete slab work to attend the meeting. Representatives to be present shall include personnel who are directly involved in overseeing the work for each placement and who have authority to control the concreting work.
 5. Notify all required attendees in writing of scheduled time and place at least two weeks in advance of meeting. Include copy of agenda with invitation.
 6. The meeting shall convene only when all parties are present.
 7. Attendees shall include, but not be limited to the following:
 - a. Owner's Construction Manager.
 - b. Owner's Concrete Consultant.
 - c. Contractor.
 - 1) Project Manager.
 - 2) Superintendent.
 - d. Concrete Subcontractor
 - 1) Project Manager.
 - 2) Finish Foreman.
 - e. Concrete Supplier.
 - 1) Quality Control Representative.
 - f. Base Fine Grading Contractor
 - g. Owner's Construction Testing Laboratory.
 - h. Densifier Manufacturer's Representative.
 - i. Densifier Applicator and Burnished Floor Surface Installer.
 - j. Joint Filler Manufacturer's Representative.
 - k. Joint Filler Subcontractor.
 8. Meeting Minutes: Record on the agenda document, discussions of meeting and decisions and agreements reached. Submit in accordance with the requirements of Submittals paragraph.
 9. Changes to Contract Documents from recommendations or discussions at the Pre-slab Installation Meeting shall be approved in writing by Owner's Construction Manager prior to implementation.

1.5 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330.
- B. Submit submittal items concurrently for submittals shown with the same submittal date specified in the Concrete Submittal Register included at the end of this Section. Do not submit submittals of this section together with submittals in Section 03310 or any other Section. Identify submittals explicitly in accordance with the requirements of Section 01330.
- C. Submit all submittals electronically in PDF format via email, unless otherwise specified, to designated parties in the Concrete Submittal Register at the end of this Section.

- D. Sieve Analysis for Aggregate Base System: Submit current sieve analysis report for aggregate base and choker material.
- E. Concrete Finishing Sub-contractor's Qualification Statement: Submit Concrete Finishing Sub-Contractor's Qualifications Statement form included at the end of this Section including Floor Finisher Qualifications as required in Quality Assurance paragraph.
 - 1. Provide ACI certification documents for at least three finishers who will install all interior slab placements.
- F. Slab Reinforcing Bar Shop Drawings:
 - 1. Complete information for installing reinforcing, including placement plans, bar bending diagrams, splice lengths and locations, bar spacing, concrete cover, and support devices and accessories.
 - 2. Detail in accordance with ACI SP 66.
 - 3. Perimeter foundation tie reinforcing submittals is specified in Section 03310.
- G. Steel Fiber Reinforcement:
 - 1. Submittals for Review:
 - a. Product Data: Steel fiber reinforcement manufacturer's standard product description and dosage and mixing instructions.
 - 2. Informational Submittals:
 - a. Test Reports: Uniform Evaluation Service (UES) certified test results for steel fiber reinforcement.
 - b. Batch Tickets: When steel fiber reinforcement is added at a ready-mix plant, furnish batch tickets indicating:
 - 1) Information required by ASTM C94.
 - 2) Type and amount of steel fiber reinforcement added to concrete mix.
- H. Mix Design: Submit Concrete Slab Mix Design Submittal Form at the end of this Section.
 - 1. Submit only one form indicating same mix design proportions for all interior slab concrete.
 - 2. Include applicable information shown on the Mix Design Submittal Form including the following:
 - a. Proportions of cementitious materials, fine and coarse aggregate, and water.
 - b. Water cementitious material ratio, 28-day compressive design strength, slump, and air content.
 - c. 28-day flexural design (tensile) strength.
 - d. Type of cement, fly ash, slag, and aggregate.
 - e. Individual aggregate gradation.
 - f. Type and dosage of admixtures.
 - g. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
- I. Attachments to Concrete Mix Design: Submit the following with the Concrete Mix Design:
 - 1. Cementitious materials mill test reports for the following:
 - a. Portland cement.
 - b. Fly ash or slag. (If approved for ASR or corrosive soils mitigation)
 - 2. Designation, type, quality, and source (natural or manufactured) of coarse and fine concrete aggregate materials.
 - 3. Sieve Analysis Reports for Concrete Aggregate: Provide separate reports of particle distribution, calculating cumulated percentages passing for all individual aggregates required on the mix form. Sieve analysis sampling and testing for each aggregate source shall be conducted within 60 days of concrete submittal date.
 - 4. Concrete Aggregate Supplier Statement:
 - a. Stating if aggregate is possibly alkali-reactive, based on tests or past service
 - b. Stating if aggregate can possibly cause pop-outs, "D" cracking, or other disruptions due to moisture gain, freezing, or other mechanisms, based on tests or past service.
 - 5. Product data for the following concrete materials admixtures:
 - a. Water reducing.
 - b. Water reducing and retarding.
 - c. Accelerating.
 - d. Chloride ion content for each admixture.
 - 6. Chloride-Ion Content: Measured water-soluble chloride-ion content (percent by weight of cementitious materials) in accordance with ASTM C 1218.
 - 7. Concrete compressive strength data as required by ACI 301.
 - 8. Past compression test reports on each mix as required by ACI 301.

9. Time of Initial Setting: Initial setting time in accordance with ASTM C 403 if supplementary cementitious material (SCM) mix is to be used.
- J. Product Data: Brand name, chemical composition, installation directions and certificates of compliance with required standards for the following products:
 1. Vapor retarder and tape.
 2. Curing compound.
- K. Slab Joint and Placement Plan:
 1. Develop and submit slab joint and placement plan.
 2. Plan shall identify the following:
 - a. Exterior walls and column grid locations.
 - b. Extent of pours including width, length, slab placement area and volume.
 - c. Sequence of placement.
 - d. Locations of construction joints.
 - e. Location of sawn contraction joints if different from those shown on the structural drawings.
- L. Concrete Floor Protection Plan. Submit Concrete Floor Protection Plan addressing procedures specified in Part 3 of this Section.
- M. Pre-Slab Installation Meeting Documents:
 1. Record of Notification of pre-slab meeting including company name, persons contacted, and date and method of contact.
 2. Meeting Agenda.
 3. Meeting Minutes. Submit meeting minutes including attendance record to participants and Owner's Construction Manager. Minutes of the meeting shall be distributed to parties in attendance by the Contractor within 5 days of the meeting. One copy of the minutes shall also be transmitted to the Owner Construction Manager for information purposes.
- N. Delivery Tickets:
 1. Submit delivery tickets for each load of concrete delivered to site.
 2. Indicate information required by ASTM C 94 on each ticket including additional information required for slabs.
 3. Information on ticket shall include quantities of all material batched including the amount of free water in the aggregate and the quantity of water that can be added at the site without exceeding the maximum water cement ratio of the approved mix design. Aggregate moisture corrections shall be based on ASTM definitions of aggregate moisture content and absorption.
 4. Mix identification number on ticket shall match number on submitted and approved mix design.

1.6 QUALITY ASSURANCE

- A. Tolerances:
 1. Conform to most stringent requirements of ACI 117 and ACI 301 except as specified herein.
 2. Slab on grade dowels:
 - a. Install dowels within plus or minus (+/-) 1/8" in dowel alignment in vertical and horizontal planes.
 - b. Install dowels horizontally on the bulkhead at the greater depth of either mid-slab or 2-1/4 inch from slab surface to center line of the plate.
- B. Penetrating Hardener/Densifier Installer Qualifications:
 1. Minimum of 15 concrete finish applications within last 3 years similar in type and size to Work of this Contract.
 2. Provide letter of certification from the penetrating hardener/densifier manufacturer stating that installer is a certified applicator of the specified concrete finish material and is familiar with proper procedures and installation requirements required by manufacturer.
- C. Workmanship:
 1. Remove and replace or repair concrete related Work which does not conform to specified requirements including strength, tolerances and finishes as directed by Owner.
 2. Bear cost of corrections or delays to other work affected by, or resulting from, corrections to concrete Work.

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3. If results of compressive strength tests reveal deficiencies in concrete, meet requirements of ACI 301.

D. Concrete Truck Inspection:

1. Conform to ASTM C 94, NRMCA and Department of Transportation standards in state where project is located with respect to truck mixer requirements.
2. Perform inspections immediately before starting concreting operations.
3. Record the identification numbers of those trucks found to be acceptable on the basis of inspections.
4. Do not bring on site for concreting operations, any truck whose identification numbers are not recorded as acceptable. Notify CTL if non-conforming trucks are used to deliver concrete for interior.

E. Concrete Supplier Approval: Concrete Supplier and materials provided shall be fully approved by and acceptable to Concrete Subcontractor as the producer of concrete which Sub-contractor is to place and finish. Prepare Statement of Approval of Concrete Supplier stating project name, name of concrete supplier, along with the statement of approval and signatures of the Contractor and Concrete Floor Sub-contractor. Submit statement as specified in Submittals paragraph.

F. Floor Finisher Qualifications:

1. The concrete floor finishing subcontractor lead finisher and at least two additional members of the finishing crew shall be certified under the Concrete Flatwork Finisher Training and Certification Program as granted by the American Concrete Institute and shall be present during finishing of interior floor slab concrete. Certified individuals executing finish operations shall have documentation of current certification available for inspection on Site at all times.
2. The concrete floor finisher subcontractor shall be a subcontractor directly under the General Contractor and shall have experience in finishing interior floors of similar size and scope in at least 5 previous projects.

G. Owner's Concrete Consultant: The Concrete Consultant is a consultant hired by and contracted by the Owner for the purpose of reviewing proposed concrete mix design and other submittals specified herein. Testing and inspection by the Concrete Consultant is specified in Appendix B (Section 03314). The Owner's Concrete Consultant is as follows:

1. [Structural Services, Inc. \(SSI\)](#), (877) 774-2677.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Deliver materials in unopened containers with labels identifying contents. Keep containers closed and upright to prevent leakage.
- C. Mark reinforcing, accessories and embedded items for proper identification and placement location.
- D. Store Steel Fiber reinforcement in protected, dry location until used; prevent contamination by other materials.
- E. Store materials, except aggregate, off ground in dry area and in manner to prevent damage. Protect liquid materials from freezing.
- F. Stockpile aggregate in manner to prevent contamination with other materials or with other sizes of aggregates. Do not use bottom 6 inches of aggregate piles in contact with ground. Allow sand to drain until it has reached uniform moisture content before it is used.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Store admixtures in manner to prevent contamination. Protect admixtures from extreme temperatures which would adversely affect their characteristics.

1.8 PROJECT CONDITIONS

A. Air Quality:

1. Provide adequate ventilation to work area at all times.
 2. Do not operate combustible fuel equipment, with the exception of propane powered equipment found in this specification, within building perimeter walls.
 3. Do not use unvented combustion heaters during concrete placement so as to prevent exposure of concrete to excessive exhaust gases containing carbon dioxide (CO₂) or carbon monoxide (CO). During slab placement and curing periods, maximum CO₂ levels shall be 4,500 parts per million and maximum CO levels shall be 15 parts per million at concrete surface within 5 feet of any source of exhaust gases to minimize potential damage to concrete.
- B. Hot and cold weather concreting shall be in accordance with ACI 305.1 (hot weather) and 306.1 (cold weather) except as otherwise specified herein. In case of conflict, provisions stated herein shall prevail over the ACI standard specifications.
- C. Concreting in Hot, Dry or Windy Weather:
1. Determine rate of evaporation in accordance with ACI 305.1.
 2. Employ precautions as required to protect fresh concrete before and during finishing when the concrete rate of evaporation exceeds 0.1 pounds per square foot per hour or when any combination of concrete materials and weather conditions are favorable for the formation of plastic shrinkage cracks.
 - a. Cool ingredients before mixing to reduce concrete temperature at time of placement. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
 - b. Dampen subgrade and forms.
 - c. Cover reinforcing steel with water soaked burlap so the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Maintain an accurate reading thermometer at the Site to check temperature of concrete
 4. Temperature of concrete at time of placing: Not to exceed 95 degrees F.
 5. Reject concrete if more than one slump adjustment, as defined in ASTM C 94, is required.
 6. Do not place concrete when forms, subgrade, aggregate base or reinforcing bars are more than 120 degrees F or the temperature differential between the forms, aggregate base, or reinforcing bars and concrete will create conditions favorable for settlement cracks or thermal cracking.
- D. Concreting in Cold Weather:
1. Minimum base surface temperature and ambient building air temperature shall be 55 degrees F during placement and throughout curing period except as otherwise specified herein. In case of conflict, provisions stated herein shall prevail over the ACI standard specifications.
 2. Measure and record concrete temperature during protection period at regular time intervals, but not less than 3 times per 24 hours.
 3. Do not place slabs on subgrade, or base that is more than 20 degrees F cooler than concrete. Warm subgrade, or base to decrease temperature differential to 20 degrees F or less.
 4. Minimum concrete temperature as measured at the point of discharge shall be 60 F.(65 F for approved SCM mix)
 5. Do not use unvented combustion heaters during concrete placement so as to prevent exposure of concrete to excessive exhaust gases containing carbon dioxide (CO₂) or carbon monoxide (CO). During slab placement and curing periods, maximum CO₂ levels shall be 4,500 parts per million and maximum CO levels shall be 15 parts per million at concrete surface within 5 feet of any source of exhaust gases to minimize potential damage to concrete.
- E. Placing Environment:
1. Slab on ground concrete and concrete over metal deck shall be placed within a completely enclosed structure after the roof membrane is completely installed and watertight.
 - a. Roof construction, overhead painting, and roof drainage system shall be complete and weather tight prior to placement of concrete slabs.
 - b. Lighting: Permanent lighting or equivalent temporary lighting shall be operational during all slab placements.

PART 2 PRODUCTS

2.1 MATERIALS

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- A. Subject to compliance with project requirements, provide products as manufactured by the following to the extent as specified hereinafter for the specific product:
1. [BASF Admixture Systems](#), (800) 628-9990.
 2. [BASF Building Systems](#), (800) 433-9517.
 3. [BW Manufacturing, Inc.](#), (616) 447-9076.
 4. [Commercial Metals Company](#) (214) 689-4300.
 5. [Dayton Superior](#) (877) 416-3439.
 6. [DBB \(Dowel Bars and Baskets\) Co.](#) 816.994.9090.
 7. [Dustless Technologies](#), (435) 637-5885.
 8. [Euclid Chemical Co.](#), (877) 438-3826.
 9. [Fortifiber Building Systems Group](#), (800) 773-4777.
 10. [L.M. Scofield](#), (800) 800-9900.
 11. [L&M Construction Chemicals](#), (402) 453-6600
 12. McTech Group, (866) 913-8363.
 13. [PNA Construction Technologies](#), (800) 542-0214.
 14. [Raven Industries, Inc.](#), Sioux Falls, SD (800) 635-3456.
 15. [Sika Corp.](#), (Sika and Greenstreak products), (800) 933-7452.
 16. [Husqvarna](#), (800) 288-5040.
 17. [SpecChem](#) (866) 791-8700.
 18. [Stego Industries, LLC](#), (877) 464-7834.
 19. [GCP Applied Technologies](#) (formerly W.R. Grace and Co.), (713) 223-8353.
 20. [W.R. Meadows, Inc.](#), (847) 214-2100.
 21. [Vexcon Chemicals, Inc.](#), (888) 839-2661.
- B. Substitutions: Comply with the requirements of Section 01600 unless specified otherwise herein.

2.2 AGGREGATE BASE AND CHOKER MATERIALS

- A. Aggregate Base Material:
1. Gradation: Conform to requirements shown on the Structural Drawings.
 2. Material passing the No. 200 sieve shall be clean granular fill with less than 3% clay and/or friable particles.
- B. Aggregate Choker Material: Clean granular fill with less than 3% clay and/or friable particles. Use one of the following gradations:
1. ASTM D 448 No. 10 with 6% to 12% passing No. 200 sieve.
 2. Material meeting the following gradation:

Standard Sieve Size	% Passing
No. 4	85-100
No. 8	75-95
No. 16	55-75
No. 50	22-45
No. 100	10-30
No. 200	6-12

2.3 FORMWORK

- A. Forms:
1. Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces.
 2. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
 3. Provide lumber dressed on at least two edges and one side for tight fit.
 4. Bevel top outside edge of form.
 5. Do not use partial depth forms.

- B. Form Release Agent:
1. 100% biodegradable, non-toxic, 100% natural organic chemical release agent. Will not cause surface imperfections, non-staining, and compatible with field applied paints, toppings, curing compounds, and other coatings. Use same brand form release agent for all forms. Provide one of the following:
 - a. [Form-EZE Natural](#) by Euclid.
 - b. [Bio-Release EF](#) by Dayton Superior.
 - c. [Star Seal EF V Release](#) by Vexcon.
 - d. [BioStrip WB](#) by SpecChem.

2.4 REINFORCEMENT

- A. Reinforcing Bars:
1. ASTM A 615, deformed, Grade 60.
 2. ASTM A 706, deformed, Grade 60.
- B. Welded-Wire Reinforcement: ASTM A 1064:
1. Plain, fabricated from as-drawn steel wire into flat sheets.
 2. Deformed steel wire, flat sheet.
- C. Steel Fiber Reinforcement:
1. Standard Fiber:
 - a. Description: High-carbon, galvanized, cold-drawn steel wire conforming to ASTM A820, Type 1, free from surface contaminants.
 - b. Tensile strength: 50 KSI (345 MPa).
 - c. Galvanized coating thickness: Minimum 3 grams per square meter.
 2. Micro-Fiber Reinforcement (Alternate Option):
 - a. Source: **Helix 5-25 by Helix Steel** (www.helixsteel.com) or approved substitute
 - b. Description: High-carbon, galvanized, cold-drawn steel wire conforming to ASTM A820, Type 1, continuously twisted about its axis, free from surface contaminants.
 - c. Tensile strength: 268.3 KSI (1850 MPa).
 - d. Galvanized coating thickness: Minimum 3 grams per square meter.
 - e. Length: 1.0 inch (25 mm).
 - f. Equivalent diameter: Maximum 0.02 inch (0.50 mm).
- D. Tie Wire:
1. Minimum 16 gage annealed type.
- E. Reinforcing Support Devices:
1. Manufactured support devices of metal (wire bar), concrete, or recycled plastic devices conforming to CRSI Manual of Standard Practice.
 2. Precast concrete bar supports shall have minimum compressive strength of 3500 psi.
 3. Plastic accessories shall have a minimum of 50% recycled content.
 4. Do not use wood, clay brick, and other devices that can expand due to moisture gain.
 5. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 6. When precast concrete bar supports are used over aggregate base, or over waterproof membranes and vapor retarders, properly embed tie wires to prevent penetration of substrate.
 7. Properly size foot of bar supports or similar devices to prevent settlement on base material or prevent puncture of vapor retarder on vapor barrier.
 8. When supporting multiple layers of reinforcement, provide the proper size and spacing of bar supports or similar devices to prevent deformation of plastic and to retain rebar within position tolerances.
- F. Plate Dowels – Typical Formed Construction Joints:
1. Provide plate dowels consisting of smooth steel plate bars, ASTM A 36 or ASTM A 108 steel. Do not grease dowels. Provide the following:
 - a. **Diamond Dowel System** by PNA Construction Technologies,
 - 1) Slab thickness 4 inches to 6 inches: size 1/4 inch x 4-1/2 x 4-1/2 inch dowels.
 - a) Spacing: 18 inches on center.
 - 2) Slab thickness 7 inches to 8 inches: size 3/8 inch x 4-1/2 x 4-1/2 inch dowels.

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- a) Spacing: 18 inches on center.
 - 3) Slab thickness 9 inches to 12 inches: size 3/4 inch x 4-1/2 x 4-1/2 inch dowels.
 - a) Spacing: 18 inches on center.
- G. Joint Edge Protection – Formed Construction Joints where noted on drawings:
 - 1. Provide permanent joint edge protection and plate dowels. Provide the following:
 - a. **Armor-Edge System** by PNA Construction Technologies
 - 1) Diamond Dowels: size 3/4 inch x 4-1/2 x 4-1/2 inch dowels.
 - a) Dowel Spacing: 18 inches on center.
 - 2) Order with joint filler support plate at bottom of vertical plates.
- H. Plate Dowel Baskets – Sawed Contraction Joints:
 - 1. Dowels shall be suspended at mid-slab depth with welded wire, “A” frame, side supports.
 - a. Minimum diameter wire for side frames shall be 0.306 inch.
 - b. Side frames shall consist of a minimum of two longitudinal wires running parallel with the joint to insure proper suspension of dowel during construction over base material.
 - c. Dowels are to be welded to the frame at alternating ends.
 - 2. Dowel shall be smooth ASTM A 36 steel plate as follows:
 - a. Plate bar dowels: 2 inches x 3/8 inch x 12 inches at 24 inches on center.
 - 3. Dowels must be sawed or laser cut, not sheared.
 - 4. Subject to specified requirements, provide dowel basket systems by the following manufacturers:
 - a. Plate Dowels:
 - 1) **PD3 Basket Assembly** by PNA Construction Technologies,
 - a) Slab thickness 7 inches to 8 inches: size 3/8 inch x 2 inch dowels.
 - b) Slab thickness 9 inches to 12 inches: size 3/4 inch x 2-1/2 inch dowels.
 - c) Dowel Spacing: 24 inches on center.
- I. Round Dowels – Formed Construction Joints only where noted on plan:
 - 1. Dowels shall be installed at mid-slab depth.
 - 2. Dowel shall be smooth ASTM A 615 (Grade 40) round bars as follows:
 - a. Round bar dowels: 5/8 inch diameter x 14 inches long at 18 inches on center.
 - 3. Provide bond break between concrete and entire dowel length with manufacturer applied Tektyl 506 coating or approved equal.
 - 4. Dowels must be drilled or cast in place.
 - 5. Subject to specified requirements, provide dowel basket systems by the following manufacturers:
 - a. Round Dowels:
 - 1) Commercial Metals Co.
 - 2) Dayton Superior Paving Products.
 - 3) DBB (Dowel Bars and Baskets) Co.
 - 4) Equivalent approved products.

2.5 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type I or II. Use only one brand throughout project.
- B. Fly Ash: ASTM C 618, Class C or F. Use only one type and source throughout project.
- C. Slag: ASTM C 989, Grade 100 or 120. Use only one type and source throughout project.
- D. Concrete Aggregate:
 - 1. Conform to ASTM C 33:
 - a. No coal or lignite in concrete that will not be covered by building materials or soil.
 - b. Fine aggregate grading requirements as defined in Section 6.1 of ASTM C 33 shall be strictly met without deviation.
 - 2. If manufactured fine aggregate is used, blend with minimum 50% natural materials.
 - 3. Coarse Aggregate:
 - a. Nominal maximum coarse aggregate size shall be 1 inch for slabs > 5-1/2 inch thick.
 - b. Nominal maximum coarse aggregate size shall be 3/4 inch for slabs ≤ 5-1/2 inch thick.

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- c. The nominal maximum size of an aggregate is the smallest sieve size through which the major portion of the aggregate must pass, with 1% to 5% retained on the nominal maximum size sieve.
 4. Adjust proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution characteristics, unless otherwise approved:
 - a. Coarseness Factor of 60 to 75%.
 - 1) The Coarseness Factor (CF) is the percent of combined aggregate retained on the #8 sieve that is also retained on the 3/8 inch sieve.
 - 2) The Coarseness Factor is calculated as follows: $CF = \frac{\text{Aggregate retained on } 3/8'' \text{ sieve}}{\text{Aggregate retained on } \#8 \text{ sieve}}$.
 - b. Adjusted Workability Factor:
 - 1) The Workability Factor (WF) is the percent of combined aggregate that passes the #8 sieve.
 - 2) The Adjusted Workability Factor (Adj-WF) is calculated as follows:
 - a) $\text{Adj-WF} = \text{WF} + \left[\frac{\text{Cementitious Material} - 564 \text{ lbs}}{37.6} \right]$
 - 3) The range of accepted Adj-WF for a given CF is as follows:
 - a) $\text{Adj-WF} = [(11.25 - .15 \text{ CF}) + 36] \pm 2.5$.
 - c. Combined percent retained on any given sieve size shall not exceed 24%.
 - d. See Coarseness Factor Chart at the end of this Section.
 5. Aggregate gradation requirements of ASTM C 33 may be waived in order to meet ranges specified
- E. Water: ASTM C 1602.

2.6 CHEMICAL ADMIXTURES

- A. Provide admixture products as specified below. Within each product listing, provide one of the products specified. When specifically allowed within each product listing, equivalent admixture products by other manufacturers meeting the specified ASTM standards may be used upon submittal of product data and approval by SER.
- B. Water Reducing Admixture: ASTM C 494, Type A.
 1. Eucon or Plastol Series by Euclid.
 2. [MasterPozzolith](#), [MasterPolyheed](#), or [MasterGlenium](#) Series by BASF Admixtures.
 3. WRDA, Daracem, Mira, Zyla or Adva Series by GCP Applied Technologies.
 4. Plastiment, Plastocrete, ViscoCrete, Sikaplast, or Sikament Series by Sika Corp.
 5. Equivalent approved products.
- C. Water Reducing and Retarding Admixture: ASTM C 494, Type B or D.
 1. [Eucon Retarder 75](#) by Euclid.
 2. [MasterPozzolith](#) or [MasterSet DELVO](#) Series by BASF Admixtures.
 3. Recover or [Daratard 17](#) by GCP Applied Technologies.
 4. [Plastiment or Plastocrete Series](#) by Sika Corp.
 5. Equivalent approved products.
- D. Accelerating Admixture: ASTM C 494, Type C or E.
 1. [Accelguard 80](#) by Euclid.
 2. Daraset Series, Daracel, Lubricon, Polarset, or DCI by GCP Applied Technologies.
 3. [MasterSet](#) Series by BASF Admixtures.
 4. [Plastocrete 161 FL](#), [Plastocrete 161 HE](#), [Sikasent NC](#), [Sika Rapid 1](#), or [Sikasent HE](#) by Sika Corp.
 5. Equivalent approved products.
- E. Water Reducing Admixture: ASTM C 494, Type F. Do not use high range, Type F, or all range water reducing admixture at Type F dosage rates.
- F. Evaporation Retardant: Water-based polymer, sprayable.
 1. [EucoBar](#) by Euclid
 2. [MasterKure ER 50](#) by BASF Admixtures.
 3. Conspec [Aquafilm](#) by Dayton Superior.
 4. E-Con by L&M.
 5. SpecFilm RTU by SpecChem.

2.7 RELATED MATERIALS

- A. Screed Chairs: Metal.
- B. Vapor Retarder: ASTM E 1745, Class A, sheet membrane material, rolled, as noted below:
 - 1. Top Layer (Vapor Retarder):
 - a. Thickness (Standard Concrete Placement): Not less than 15 mils.
 - b. Thickness (Pumped Concrete Placement): Not less than 10 mils.
 - 2. Bottom Layer (Slip Sheet):
 - a. Thickness: Not less than 6 mils.
 - 3. Approved Suppliers:
 - a. [Stego Wrap](#) by Stego Industries.
 - b. [Moistop Ultra](#) by Fortifiber.
 - c. [Perminator](#), by W.R. Meadows.
 - d. [Yellow Guard](#) by Poly-America.
 - 4. Do not use folder sheets.
- C. Vapor Retarder Tape and Adhesive: Tape and adhesives for sealing laps, punctures, tears and penetrations shall be pressure-sensitive, waterproof adhesive tape, 2 inches minimum width and compatible with retarder.
- D. Pre-Densifier Floor Cleaner: As recommended by densifier manufacturer.
- E. Densifier: Concrete lithium based chemical densifier specifically for concrete surface treatment which reacts chemically to the concrete surface forming a clear, dense, durable, hard, abrasion-resistant surface. Product shall be a colorless, odorless, water-based solution that is less than 50 VOC.
 - 1. SureLock, by American Decorative Concrete.
 - 2. Pentra-Sil (NL) by Convergent.
 - 3. Ashford Formula by Curecrete.
 - 4. Consolideck LS by Prosoco.
 - 5. MasterKure HD 300WB, by BASF (if approved for carbonated or dusting slab).

2.8 CONCRETE CURING MATERIALS

- A. Curing Compound:
 - 1. [SC Cure 500](#) by SpecChem.
 - 2. Penetrating Curing Agent (PCA) by Ameripolish.

2.9 CONCRETE MIX

- A. General:
 - 1. Use only materials and their proportions included in approved Concrete Mix Design.
 - 2. Maintain same source of cementitious materials, chemical admixtures, coarse and fine aggregates for the entire floor slab.
 - 3. Measure and mix ingredients in accordance of ASTM C 94.
 - 4. Concrete supplier may proportion materials by field experience or proportion concrete materials by laboratory trial batches for strength compliance.
- B. Strength: As indicated on Drawings
- C. Workability: Concrete shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding.
- D. Supplementary Cementitious Materials (SCM):
 - 1. Use SCM in the concrete mix only for mitigation of potential aggregate reactivity.
 - 2. Ternary blended materials are not acceptable. Concrete mix shall contain either fly ash or ground granulated blast furnace slag (GGBFS) but not both.
 - 3. Fly Ash: If used to mitigate potential aggregate reactivity, only Type F fly ash may be used and shall have the following maximum properties: 1.5% available alkali and 8.0% CaO.
 - 4. Ground Granulated Blast Furnace Slag (GGBFS): If required to mitigate potential sulfate exposure or

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aggregate reactivity, up to 50% GGBFS substitution for Portland cement may be used.

- E. Portland Cement: Use 520 pounds minimum for all interior slab mixes.
- F. Water/Cementitious Materials Ratio: Interior Floor Slabs: 0.53 maximum.
- G. Air-Entraining Admixture: Do not air-entrain interior floor slabs with troweled finish.
- H. Slump: Slump at the point of placement shall not exceed 5 inches subject to the requirement that concrete shall be of a consistency to be worked readily into forms and around reinforcement without segregation, voids, or excessive bleeding. Maximum slump variance shall be 2 inches.
- I. Admixtures:
 - 1. Water-reducing admixture may be added to improve workability only beyond 3 inches of initial water slump. Mix shall have adequate water to produce consistent plastic material properties.
 - 2. Concrete slab mix shall contain only one water reducing admixture.
 - 3. Use admixtures in accordance with manufacturer's recommendation.
- J. Calcium Chloride Admixture:
 - 1. Not permitted in slab applications.
- K. Steel Fiber Reinforcement:
 - 1. Add to concrete mix in accordance with ASTM C1116.
 - 2. Dosage rate: As indicated on Drawings and in accordance with manufacturer's instructions.

2.10 MIXING

- A. Ready-Mixed Concrete:
 - 1. Mix and transport in accordance with ASTM C 94 and ACI 301 except as specified.
 - 2. Reset drum revolution counter to zero on concrete truck when water is added to drum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Conform to manufacturer's printed instructions for materials and equipment.
- B. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause difficulty in placing concrete.

3.2 PREPARATION

- A. Preplacement Inspection: All trades and participants involved shall verify that preparations are in conformance with Contract Documents.
- B. Cleaning Equipment: Remove hardened concrete and foreign materials from mixing and conveying equipment.
- C. Ensure that all work is properly coordinated:
 - 1. Structural Drawings and Specifications with those of other disciplines.
 - 2. Use final corrected submittals.
- D. Roof construction, RTUs, overhead painting, and roof drainage system shall be complete and weather tight prior to placement of slabs.

3.3 AGGREGATE BASE PLACEMENT

- A. Unless otherwise indicated on the Drawings, place aggregate base as specified herein.

- B. Aggregate Base:
 1. Install aggregate base where shown on Drawings.
 2. Compact to final thickness shown on Drawings in layers not exceeding 6 inches with minimum of 2 passes per layer with vibratory compactor.
 3. Compact fill to 98% of aggregate's Standard Proctor as determined by Method D of ASTM D 698.
 4. Leave top of base up to 2 inches low until just prior to concrete placement.

- C. Aggregate Base Fine Grading:
 1. Compact to final thickness noted with 2 passes minimum vibratory compactor to produce smooth, flat, dense surface.
 2. Do not allow excess moisture or soft soil beneath vapor retarder at time of placing concrete.
 3. Level off aggregate base top surface with aggregate choker material as necessary as follows:
 - a. To reduce surface friction and to meet specified fine grade tolerances specified below. Typically required in areas exposed to rain, traffic, or excavation for pits and buried utilities.
 - b. Where aggregate base material does not have sufficient fine particles to produce a surface that is free of exposed aggregate or surface voids greater than 3/8 inch in size at time of slab installation.
 - c. Choker material is not required in aggregate base with adequate surface fines and may only be installed from a dusting to up to 3/4 inch maximum thick.
 4. Use laser guided equipment to establish specified base elevation.
 5. Provide dry, smooth, flat, dense surface. Take corrective action if rutting or pumping is evident during the preparation of the soil support system.
 6. Proof-roll 48 hrs maximum prior to concrete placement. Depression under a fully loaded concrete truck shall not exceed 1/2 inch.

- D. Slab on Ground Aggregate Base Fine Grade Tolerance: +0 inch, -3/4 inch with transition no greater than 3/4 inch vertically to 8 inches horizontally for level slab.

3.4 FORMWORK

- A. Design, construct, and remove formwork and related items in accordance with most stringent requirements of ACI 117 and 347.
- B. Install wood forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
- C. Provide slab side forms, of form materials specified, full depth, with beveled, level, and smooth top surface for all slabs on ground where SOV is greater than FF 35 / FL 25.
- D. Provide slab side forms such that by placing a 10-foot straightedge, form does not exceed 1/8 inch variation.
- E. Prefabricated Access Pit Form: Install in accordance with manufacturer's instructions.

3.5 VAPOR RETARDER INSTALLATION

- A. Install vapor retarder in accordance with ASTM E 1643
 1. Exception: Paragraph 10 – Slab Moisture Content provisions shall not apply.
- B. Sequence installation of vapor retarder no more than 40 feet in advance of laser screed strike-off.
- C. Install slip sheet and vapor retarder layers directly under slabs only where shown on Drawings.
- D. Bottom Layer (Slip Sheet):
 1. Following leveling and tamping of prepared base for slabs, place slip sheeting with longest dimension perpendicular to direction of placement.
 2. Lap joints 6 inches minimum. Do not tape joints or penetrations.
- E. Top Layer (Vapor Retarder):
 1. Following placement of slip sheeting, place vapor retarder sheeting with longest dimension parallel with direction of placement.

2. Lap joints 6 inches minimum and seal continuously with specified tape.
3. Seal punctures and tears in membrane caused by bar chair feet, screed anchors, or utility penetrations with specified tape.

3.6 PLACING REINFORCEMENT

- A. Place reinforcing in accordance with of ACI 117, ACI 301 and CRSI Manual of Standard Practice and Placing Reinforcing Bars.
- B. Accurately place and secure reinforcement against displacement by firmly wiring at intersections and splices.
- C. Turn wire ends away from concrete exterior.
- D. Ensure reinforcing is clean, free from defects and kinks, loose mill or rust scale or coatings that will reduce bond.
- E. Protect exposed reinforcing bars, inserts and plates intended for bonding with future expansion from corrosion.
- F. When welding of reinforcement is specified, comply with AWS D1.4. Do not tack weld crossing bars for assembly of reinforcement, supports or embedded items.
- G. Slab on Ground and Pavement Dowels:
 1. Secure dowels and sleeves (if required) perpendicular to joint and parallel to finished concrete surface.
 2. Use prefabricated dowel supports at ends of dowels to maintain alignment, if necessary.
 3. Dowel alignment shall be within specified tolerances.
 4. Dowels shall be manufactured to provide bond break between steel and concrete.
 5. Do not grease dowels.
 6. Install dowels at construction joints in accordance with manufacturer's recommendations.
 7. Install slab on ground plate dowels within +/- 1/8 inch in dowel alignment in vertical and horizontal planes.
 8. Install slab on ground plate dowels horizontally on the bulkhead at the greater depth of either mid-slab or 2-1/4 inch from slab surface to center line of the plate.
 9. Center slab on ground dowels in baskets at contraction joints horizontally within +/- 2 inches of the saw cut joint.
 10. Install plate dowel baskets at contraction joints in accordance with manufacturer's recommendations and specified requirements.

3.7 CONVEYING

- A. Handle concrete from mixer to place of final deposit as rapidly as practicable and in manner which will assure obtaining specified quality of concrete.
- B. Concrete materials for interior slabs on ground shall be directly deposited from the concrete ready mix truck tailgate or conveyed or transported by buggy to point of placement. Pump placement of materials shall not be performed for interior slabs unless approved in writing for access inside a previously existing structure.
- C. Re-tempering: Discard concrete which has already begun to set. Do not re-temper with water.
- D. Equipment: Provide mixing and conveying equipment of proper size and design to ensure a continuous flow of concrete to delivery end. Do not use aluminum pipe or equipment in contact with concrete.
 1. Mixers, agitators and non-agitating units: Conform to ASTM C 94 and current certification requirements of Department of Transportation in state where concrete plant is located.
 2. Belt Conveyers:
 - a. Use only types which will not cause segregation.
 - b. Discharge runs over 30 feet into hopper
 3. Chutes: Metal or metal lined not to be installed at slopes greater than 1 vertical to 3 horizontal.
 4. Runways:
 - a. Provide runways or other means above finished concrete level for wheeled conveying equipment.
 - b. Do not support runways on reinforcing.
 - c. Do not wheel equipment directly over reinforcing or metal deck.
 5. Pumps:

- a. Use pump hoses and other slickline components with 5 inch minimum inside diameter.
- b. For slickline reducers, reduction in diameter shall not exceed 1 inch over a 5 foot length.

3.8 PLACING CONCRETE

- A. Unless otherwise specified, place concrete in accordance with the requirements of ACI 301.
- B. The following personnel shall be present during all slab placements: Contractor's Superintendent, Concrete Subcontractor's Finish Foreman, Concrete Supplier's Quality Control Representative, and Owner's Construction Testing Laboratory.
- C. Deliver concrete from only one concrete batch for any given days placement. The same concrete plant shall be used for the entire interior slab placements unless approved in writing prior to change.
- D. Depositing:
 1. Place concrete in one continuous placement up to a maximum of 50,000 square feet.
 2. Placement panels shall be rectangular without "L" or "T" shapes.
 3. Do not deposit concrete which has partially hardened or has been contaminated by foreign matter.
 4. Deposit concrete continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause seams or planes of weakness.
 5. Between construction joints, place concrete in a continuous operation such that concrete is plastic at all times and flows readily into spaces between reinforcement.
 6. Use placement procedures to avoid segregation.
 7. Deposit concrete as near as possible to its final position.
 8. Do not place concrete over standing water, mud, frost, ice or snow.
 9. Do not use wet screeds.
- E. Consolidation:
 1. Consolidate concrete complying with ACI 301 by vibrating, spading or rodding so that concrete is thoroughly worked around reinforcing.
 2. Do not insert vibrator into portions of concrete that have begun to set.
 3. Keep spare vibrator on job site during concrete operations.
 4. Consolidate and screed slabs to allow construction joint pattern as indicated on Structural Drawings and as specified. Consolidate concrete by vibrating laser screeds. Other vibratory screeding methods are acceptable only in areas where laser screed is not accessible.
 - a. Check laser screed level head a minimum of 3 times during each pour. Use feeler gauge to measure deviations. If deviations are present, replace head with a new straight one.
 5. Use internal vibration along construction joints at both formed and slab abutments. Vibrate under plate dowels. Mark forms before concreting to properly locate dowels after concreting.
 6. Do not use grate tampers, jitterbugs, or mesh rollers.

3.9 FLOOR SLAB FINISHING

- A. Equipment:
 1. Provide a minimum of five, eight foot or larger, properly operating, ride-on finishing machines on site and available for slab placements. Provide a minimum of six finishing machines on slab placements over 20,000.
- B. General:
 1. Do not add water to any slab surface during finishing operations.
 2. Do not add cement to any slab surface during finishing operations.
 3. Perform no finishing operation while water is present on slab surface.
- C. Initial Leveling:
 1. Complete bull floating, darbying and straight-edging before any bleed water is present on slab surface.
 2. Use a 10 feet wide minimum channel float for initial and later leveling instead of bull float where overall floor tolerances specified are greater than FF 20 / FL15.
- D. Hand and Power Floating:
 1. Do not start floating until following conditions are met:

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- a. Bleeding is complete and water is gone, including water sheen on slab surface.
- b. Mortar is not thrown by rotating blades of power float.
2. The finisher shall determine the proper time to start finishing procedures for interior slab placements on the basis the above conditions. It is noted for advisory purposes, however, that typical setting characteristics of concrete materials will allow for initial power floating to begin 3-1/2 hour's \pm 1 hour after initial strike-off (screeding), at which time the concrete should support a finisher on foot without more than approximately a 1/4 inch indentation in the slab surface. Variations in concrete materials, nature, and concrete temperature will cause setting behavior to vary.
3. Do not use following tools for floating:
 - a. Power troweling machines with trowel blades.
 - b. Fresno or other type of wide metal trowel.
 - c. Power floating machine with water attachment for wetting concrete.
4. Float three times minimum with each floating at right angles to previous floating, and final pass at 45 degrees to previous pass.

E. Troweling for Interior Slabs:

1. Hand or power float floor before starting troweling.
2. For first troweling, keep blade as flat as possible and use low speed, minimizing "washboard" or "chatter marks" and "pitting".
3. Trowel two times minimum with first two trowelings at right angles. Some burn marks are acceptable as determined in review of the test slab. Cease troweling before trowel blades scratch surface.
4. Allow time between trowelings for concrete to stiffen and water sheen to disappear.
5. Do not add water to slab surface during troweling.
6. Do not ride trowels on existing hardened concrete slabs. Trowels shall be carried off of slab surfaces. When parking power trowels on fresh concrete, place on top of plywood or spray area with evaporation retarder before placing trowel on top of slab.
7. Ensure kneeboard impressions, trowel marks or chattered areas are not evident after floor is finished.
8. Provide dense, smooth trowel surface, uniform in texture. Random, mottled burn marks are desired and acceptable. Refer to approved permanent test panel.
9. Finish surface to produce maximum sheen free of scratches and trowel marks.

F. Scratch Finishing: After floating lightly scratch surface with stiff brush.

G. Broom Finishing:

1. Draw flexible bristle broom across surface to produce non-slip texture.
2. Broom in direction transverse to traffic or at right angles to slope of surface unless otherwise shown.

3.10 CONCRETE FINISHES

A. Troweled Finish:

1. Use for exposed interior walking surfaces and surfaces to be covered with carpet, resilient flooring and other thin film finish coating systems.
2. Densification and burnishing finish of interior slabs is specified in Section 03362.
3. Use for other locations where shown or scheduled on the drawings.
4. Use for exposed interior warehouse walking surfaces.
5. Use for exposed interior office walking surfaces.
 - a. Polish concrete floor in accordance with Section 03363.

B. Scratched Finish: Use for surfaces to receive mortar setting beds for tile and other bonded applied cementitious finish flooring materials, except bonded concrete floor toppings..

C. Broom Finish: Use where indicated on drawings.

D. Do not disturb surface paste covering Steel Fiber reinforcement during finish operations.

3.11 JOINTS

A. Provide construction, isolation, and contraction joints as indicated on Drawings and as noted below.

1. Bulkheads for construction joints shall be 1-1/2 inch minimum lumber with top outside edge beveled 30

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degrees minimum, leaving 1/2 inch to 3/4 inch level surface. Do not use permanent preformed metal bulkheads.

2. Provide bulkheads full depth of slab section.
3. Space joints to allow one continuous placement between bulkheads but not greater than 140 lineal feet.
4. Maximum length-to-width ratio for concrete panels defined by walls or joints shall be 1-1/2:1.
5. Do not locate longitudinal construction joints in action alleys.
6. Unless otherwise shown on the Drawings, do not extend reinforcement, corner protection angles, bars, or other fixed metal items through joints in slabs or through joints between slabs on ground and vertical surfaces.
7. Match joints in walls and curbs with joints in slabs on ground and pavements.
8. Extend joints across tops of walls and curbs unless noted otherwise on Drawings.
9. Isolation Joints: Form isolation joints in accordance with Section 07900.
10. Verify joint cleanout methods include HEPA-rated filter systems as specified herein.

B. Provide contraction slab joints as indicated on Drawings for slab on ground only.

1. Use saws, blades, skid plates, and accessories by [Soff-Cut](#) (800) 288-5040 or approved equal.
2. Provide at least two Soff-Cut saws with blades capable of achieving the required depth of saw cut. Employ number of saws and workers sufficient to complete cutting saw joints before shrinkage produces cracking.
3. Start cutting sawed joints as soon as concrete has hardened sufficiently to prevent raveling or dislodging of aggregates. This will typically be from 1 hour in hot weather to 4 hours in cold weather after completing finishing of slab in that joint location.
4. Adhere felt or similar material to the bottom of the saw base plate as necessary to minimize surface scratching and debris build up.
5. Saw cut to width of 1/8 inch by 1/4 the slab depth, unless noted otherwise on Drawings.
6. After saw cutting immediately clean slab surface of all sawing residues using a vacuum with HEPA-rated filter.
7. Extend sawed joint to the slab boundaries and abutments, including columns, drains, and other penetrations in the path of a defined joint. Implement methods and timing of the saw cut beyond the limits of the Soff-Cut saw reach to provide a consistent depth of cut with minimal raveling of joint edges.
8. Contraction slab joints are NOT required for slab on metal deck.
9. See Drawings for additional requirements.

C. Saw-Cut Control Joint Dust Collection: Connect a one of the following dust collection systems directly to each Soff-Cut saw being used. Provide collection system model recommended by the manufacturer to maintain dust emissions below the permissible level. Immediately clean remaining debris after cutting and prior to cure.

1. PulseVac by BW Manufacturing.
2. SoffVac by by Husqvarna USA.
3. DustDroid by Dustless Technologies.
4. Substitutions: Not permitted.

D. Joint filling and sealing of concrete floors is specified in Section 07900.

E. Joint filling of concrete floors under resilient tile and carpet floor covering is specified in Sections 09650 and 09680 respectively.

3.12 CURING

A. Curing Compound (Temporary Film Forming):

1. Apply curing compound prior to saw cutting joints and as soon as concrete surface will not be damaged by curing operations.
2. Clean slab surface and joints using a vacuum with HEPA-rated filter and remove loose or compacted saw debris prior to curing compound application.
3. Apply compound at a rate of 700 to 1200 square feet per gallon with high volume, low pressure, atomized sprayer in accordance with manufacturer recommendations. Prevent over-application in excess of specified rate.
4. Spread compound evenly using mopping pads. Mopping pads shall be Rubbermaid 24 inch Microfiber Wet Room Pad or equivalent.
5. If whitening from over application occurs, consult manufacturer for removal of product with hot water and aggressive scrubbing.
6. Do not allow compound to accumulate and puddle.

7. Do not use polyethylene sheets or other impervious covers on exposed interior floors.

3.13 FORM REMOVAL

- A. Do not remove forms until concrete has hardened sufficiently to support its own weight and imposed construction loads.
- B. Remove forms in manner to avoid damage to concrete.
- C. Formwork for slabs, curbs and other parts not supporting vertical load of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations, but in no case sooner than 12 hours.

3.14 DENSIFIER TREATMENT

- A. Densifier for concrete floor slabs is specified in Section 03362.

3.15 CONCRETE FLOOR POLISHING (BURNISHING)

- A. Burnishing concrete floor slabs which have received densifier is specified in Section 03362.

3.16 TOLERANCES

- A. Conform to most stringent requirements of ACI 117 and ACI 301 except as specified herein.
- B. Floor Flatness (FF) and Floor Levelness (FL): Unless noted otherwise on the Drawings tolerances for concrete slabs shall be in accordance with ACI 117 as follows:
 - 1. The minimum local area shall be bound on each side by column lines.
 - 2. Interior Slabs on Ground:
 - a. Specified Overall Value (SOV) FF 35 / FL 25 and Minimum Local Value (MLV) FF 25 / FL 20.
 - 3. Elevated Slabs on Steel Deck:
 - a. Specified Overall Value (SOV) FF 35 and Minimum Local Value (MLV) FF 25.

3.17 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. Responsibilities and Duties of Contractor Relative to Owner Testing:
 - 1. Notify CTL not less than 3 working days prior to placing concrete.
 - 2. Assist Owner's agency in securing field specimens
 - 3. Concrete Supplier and Aggregate Supplier shall have representatives available to assist CTL in obtaining representative samples.

3.18 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 03314).

3.19 NON-CONFORMING WORK

- A. When directed by Owner, remove and replace or repair concrete related Work which does not conform to specified requirements including strength, tolerances and finishes.
- B. When directed by Owner, remove and replace slabs-on-ground with surfaces measuring below either specified F_F and/or F_L minimum local values.

- C. At option of Owner, Contractor may be allowed to submit alternatives for remediation to slabs-on-ground measuring below either or both specified F_F and F_L minimum local values.
- D. Costs for corrective work, remedies for out-of-tolerance work, and extra testing as required by defective work shall be borne by Contractor.

3.20 PROTECTION

- A. Slab Protection:
 - 1. Protect slabs from staining prior to application of densifier specified in Section 03362.
 - 2. Protect finished floors to prevent damage including staining, gouges and scratching by construction traffic and activities until Owner possession.
 - a. Barricade concrete surfaces immediately after placing and finishing.
 - b. 3 days after placement: Foot traffic permitted. No construction materials in contact with slab surface.
 - c. 5 days after placement: Scissor lift traffic permitted.
 - 3. Keep slabs free from dirt and grime.
 - 4. Provide impact protection to slab with approved sheet materials. Remove or consolidate impact protection materials on a regular basis to prevent discoloring. The use of plastic sheets for impact protection is prohibited.
 - 5. Prohibit foot traffic by workers and others not involved in floor construction or finishing operations in areas where floor construction or finishing operations are being performed.
 - 6. Vehicles and equipment may be driven on concrete surface within building line only if the slab is protected by the following:
 - a. Diaper hydraulically-powered equipment.
 - b. Place non-absorbent drop cloths or other breathable slab protection that will not stain slab surface under parked vehicles.
 - c. Vehicles and equipment are equipped with non-marking tires.
 - d. Tire treads are inspected for debris prior to use on slab and a least once per day. Remove embedded items which may cause damage to floor slab.
 - 7. Clean up spills on slab immediately. Provide cleaning chemicals and absorptive materials.
 - 8. Pipe cutting machinery is prohibited on concrete surface within building line.
 - 9. Adequately protect concrete inserts and other embedded items from movement, mechanical injury, or from damage by elements.
 - 10. Provide access ramps of compacted earth or other means along exposed concrete edges of floor slabs to prevent equipment and machinery from impacting edges. Barricade other exposed edges to vehicular traffic which may damage edges.
- B. Concrete Floor Protection Plan: Develop Concrete Floor Protection Plan that addresses the following procedures:
 - 1. Communication of protection plan to subcontractors and vendors, including those directly contracted by the Owner.
 - 2. Procedures for compliance with slab protection requirements specified in this Section.
 - 3. When and how floor covering protection will be provided in high traffic areas.
 - 4. Condition, inspection, and operational procedures for construction equipment allowed on the slab surface.
 - 5. Procedures for cleaning up slab spills, including use of and availability of cleaning chemicals and absorptive materials at Site.
- C. Submit Concrete Floor Protection Plan as specified in Part 1 of this Section. Comply with the requirements of approved Concrete Floor Protection Plan.

3.21 CLEANING

- A. Provide daily scrubbing of the entire exposed concrete slab surface with fuel powered riding equipment that utilizes only pads and water. Daily scrubbing shall continue from time of dried initial application of surface densifier until time of area turnover, or as directed by the Owner's Construction Manager. Use white or red pads, cleaned or replaced daily, and avoid using excessive downward head pressure that may damage the slab surface.
- B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

END OF SECTION

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FULFILLMENT CENTER
 CONCRETE SLAB MIX DESIGN SUBMITTAL FORM
 (Section 03314 – Cast-in-Place Concrete Slabs)

Date _____

SUBMITTED MIX DESIGN

Interior Building Slabs

03314-001 **Natural** Concrete (gray) on ground
 Mix ID # _____

03314-002 **Natural** Concrete (gray) on metal deck
 Mix ID # _____

* Same basic proportions for all interior slab concrete

BUILDING INFORMATION

BUILDING # _____

ADDRESS _____

CITY, ST _____

GENERAL CONTRACTOR _____

COMPANY _____

JOBSITE PHONE _____

A. CONCRETE INFORMATION

Design Strength (f'c) _____ psi

Water / Cementitious Ratio _____

Total Air Content _____ %

Mix Developed From

Trial Mix Test Data (*attach test data*)

Field Experience (*attach data*)

Density

Wet _____ pcf Dry _____ pcf

Slump

_____ “ (± 1”) **WITHOUT** WR Admixture

_____ “ (± 1”) **WITH** WR Admixture

Ambient Conditions for which mix is valid

Temperature Min. _____ Max. _____

Humidity Min. _____ Max. _____

LEAVE
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 ENGINEER'S
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B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces)	
			oz / cy	oz / cwt
Water Reducing				
Water Reducing and Retarding				
Accelerating				

C. MIX DESIGN

Mix Proportions (per cubic yard)

	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	Volume (cubic feet)	% Aggregate Absorption
Cement					
Fly Ash					
Slag (GGBFS)					
Coarse Aggregate #1					
#2					
#3					
Fine Aggregate #1					
#2					
Water					
Entrapped Air Content					
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	% Passing Each Sieve (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2		Cumulative	Individual
1-1/2"								
1"								
3/4"								
1/2"								
3/8"								
# 4								
# 8								
# 16								
# 30								
# 50								
# 100								
# 200								
% of Vol								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained } 3/8'' \text{ sieve}}{\text{Combined \% cumulative retained } \#8 \text{ sieve}}$	=	
Workability Factor =	Combined % passing #8 sieve	=	
Adj-Workability Factor =	$WF + [(Cementitious \text{ Material} - 564) \div 37.6]$	=	
Allowable Adj-WF =	$Adj-WF = [(11.25 - .15 \text{ CF}) + 36] \pm 2.5$	=	Low High

D. ATTACHMENTS: Include the following with this Mix Design Report.

- Mill test reports for Portland cement.
- Mill test reports for fly ash, and ground granulated blast furnace slag materials if used in approved SCM mix.
- Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials
- Mill test reports for Portland cement, fly ash, and ground granulated blast furnace slag materials
- Separate aggregate gradation reports including all required sieve sizes
 - Gradation sieve report tests dated within 60 days of this report
 - Report for each coarse and fine aggregate material in mix
- Statement if possible reactivity of aggregate, based on tests or past service
- Statement if possible aggregate pop-outs or their disruptions, based on tests or past service
- Product data for the following admixtures:
 - Chloride ion data and related calculations
 - Water reducing
 - Water reducing and retarding
 - Accelerating
- Concrete compressive strength data used for standard deviation calculations.
- Measured water-soluble chloride ion content. (percent by weight of cement)
- Time of initial setting per ASTM C 403 if approved SCM mix is used.

E. CONCRETE SUPPLIER INFORMATION

Company Name _____ **Tel. #** () _____

Address _____

City, ST Zip _____

Technical Contact _____ **Cell #** () _____

e-mail _____

Sales Contact _____ **Cell #** () _____

PRIMARY PLANT

SECONDARY PLANT

Plant Location: _____

Miles from Site: _____

Travel Time to Site: _____

NRMCA Certified: YES NO

YES NO

State DOT Certified: YES NO

YES NO

Batch Mixing Type: DRY CENTRAL MIX

DRY CENTRAL MIX

CONCRETE FINISHING SUBCONTRACTOR'S QUALIFICATION STATEMENT

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SECTION 03314
CAST-IN-PLACE CONCRETE SLAB

Project Location: _____ Date: _____

Project Number: _____ Store Number: _____

By signing below Contractor confirms that the concrete finishing subcontractor meets the following requirements:

The concrete finishing subcontractor lead finisher and two additional members of the finishing crew are certified under the Concrete Flatwork Finisher Training and Certification Program as granted by the American Concrete Institute.

The concrete floor finishing subcontractor has experience in finishing floors of similar size and scope in at least 5 previous projects. The names and locations of these projects are as follows:

1. _____
2. _____
3. _____
4. _____
5. _____

Concrete Finishing Subcontractor Company Name and Address:

Signature of Responsible Officer: _____

Typed Name and Title of Officer: _____

Telephone Number: (_____) _____

Contractor Company Name and Address:

Signed by: _____ Date: _____

Attach certificates from the Concrete Flatwork Finisher Training and Certification Program for lead finisher and two additional members of the finishing crew.

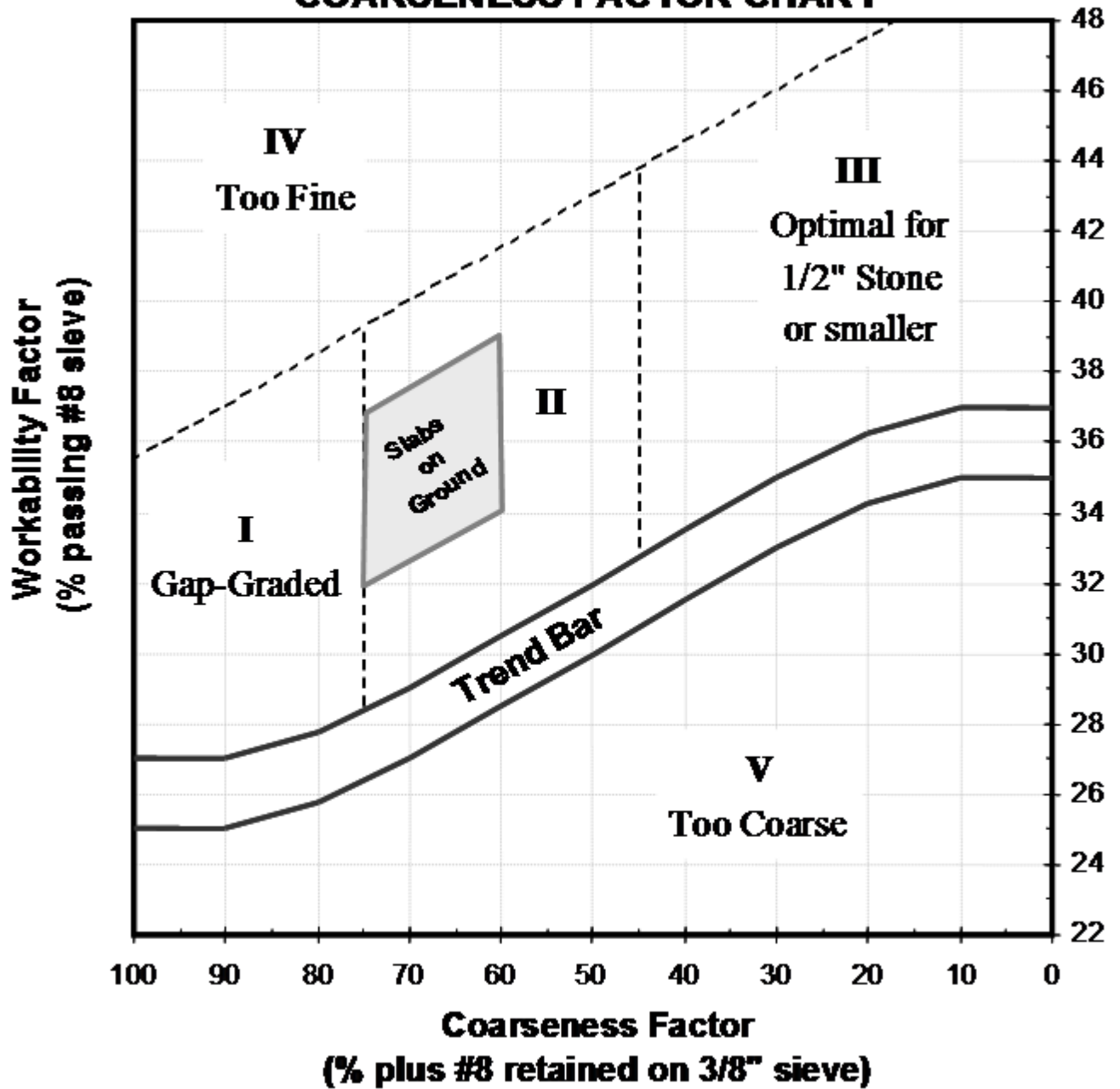
Submit one copy of this Statement to the Architect.

CONCRETE SUBMITTAL REGISTER SUMMARY (Reference Submittals paragraph in Part 1 for submittal details.)		
SUBMITTAL	SUBMIT TO	SUBMITTAL DUE
Concrete Finishing Subcontractor's Qualification Statement <ul style="list-style-type: none"> 3 ACI Finisher Certifications 	Architect	30 days prior to first pour
Sieve Analysis for Aggregate Base System <ul style="list-style-type: none"> Aggregate Base Material Choker Material 	Architect Owner's Construction Testing Laboratory (CTL)	30 days after award of Contract
Mix Design <ul style="list-style-type: none"> Submit on form provided 	Architect Owner's Construction Testing Laboratory (CTL) Structural Engineer of Record Owner's Construction Manager	30 days prior to first pour
Attachments to Concrete Mix Design <ul style="list-style-type: none"> Mill test reports Concrete aggregate designation, type, type, quality, & source Sieve analysis for concrete aggregate Concrete Aggregate Supplier Statement Product data for concrete admixtures Concrete compressive strength data Chloride-Ion content Time of initial setting 	Architect Owner's Construction Testing Laboratory (CTL) Structural Engineer of Record Owner's Construction Manager	30 days prior to first pour
Slab Reinforcing Bar Shop Drawings <ul style="list-style-type: none"> Installation details <i>Perimeter foundation tie reinforcing submittals are submitted under Section 03310.</i>	Architect Owner's Construction Testing Laboratory (CTL)	30 days prior to first pour
Product Data <ul style="list-style-type: none"> Vapor retarder Curing compound 	Architect Owner's Construction Testing Laboratory (CTL)	30 days prior to first pour
Slab Joint and Placement Plan	Architect Owner's Construction Testing Laboratory (CTL) Structural Engineer of Record Owner's Construction Manager	30 days prior to first pour
Pre-slab Installation Meeting <ul style="list-style-type: none"> Record of notification Meeting agenda Meeting minutes 	Owner's Concrete Consultant Owner's Construction Manager Owner's Construction Testing Laboratory (CTL) Submit meeting minutes to all meeting attendees.	3 days after meeting.
Concrete Floor Protection Plan	Owner's Construction Manager	Prior to first pour

CONCRETE SUBMITTAL REGISTER SUMMARY
(Reference Submittals paragraph in Part 1 for submittal details.)

SUBMITTAL	SUBMIT TO	SUBMITTAL DUE
Delivery Tickets	Owner's Construction Testing Laboratory (CTL)	With delivery of each load

COARSENESS FACTOR CHART



SECTION 03363 - POLISHED CONCRETE FLOOR FINISHES FOR INTERIOR SLABS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. For interior slabs placed under Section 03314: Progressive wet polishing and burnishing of slab surface, including application of penetrating stain protector, to specified Finish Requirements.

B. Related Requirements:

1. Section 01500 - Temporary Facilities and Controls: Requirements for control of substances that have the potential for polluting surface and/or groundwater. Requirements for storage of materials and equipment at the project site.
2. Section 01700 - Execution Requirements: Requirements for use of electrical and propane powered equipment.
3. Section 01770 - Contract Closeout.
4. Section 03314 - Cast-in-Place Concrete Slabs (Interior).

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Society for Testing and Materials:

1. ASTM D 1455 - Test Method for 60° Specular Gloss of Emulsion Floor Polish.

C. Concrete Polishing Association of America (CPAA).

1. Guideline for levels of aggregate exposure.

1.3 CLOSEOUT SUBMITTALS

- A. Comply with the requirements of Section 01770.

B. Product and Equipment Data: Submit the following manufacturer's data for products and equipment used in the specified enhancement process:

1. Manufacturer's technical product data and literature.
2. Storage and handling requirements and recommendations.
3. Manufacturer's safety data sheets and related safety requirements.
4. Product and equipment manufacturer's recommendations for slab maintenance.

C. Floor Polishing Plan and Schedule as specified in Part 1 hereafter.

D. Maintenance recommendations including:

1. Maintenance schedule and frequency.
2. List of approved cleaning and stain removal products and procedures.
3. Precautions for cleaning materials and methods that could be detrimental to burnished slab finish.

E. Completion Quality Control Test Results as specified in Part 3 herein.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Comply with current Federal, state and local air quality regulations and with Federal requirements on concrete silica dust emissions. Do not dry grind slab surface.

- B. Comply with current Federal, state and local toxicity and air quality regulations and with Federal requirements on content of lead, mercury, and other heavy metals. Do not use solvents in floor polish products that contribute to air pollution.
- C. Refer to Section 01700 for requirements related to acceptable power sources specified hereinafter.
- D. Limit and control dust and moisture created by concrete surface enhancement work to meet all local, state, and Federal ordinances, codes and laws.
- E. Limit and control damage from slurry caused by surface preparation and polishing.
- F. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
- G. Close finished slab area to traffic during application and after application for a time as recommended by manufacturer.
- H. Define affected area with orange plastic construction fencing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Owner's Division 1 specifications and manufacturer's recommendations.
- B. Deliver materials to site in original, factory sealed, unopened, new containers (drums) bearing manufacturer's name and label intact and legible, with the following information:
 1. Name or title of material.
 2. Manufacturer's standard container (drum) numbers.
 3. Application instructions.
- C. Storage:
 1. Store materials in protected and well-ventilated area at temperatures between 40 and 90 degrees F unless otherwise required by manufacturer.
 2. Keep containers sealed until ready for use.
 3. Do not use materials beyond manufacturer's shelf life limits.
- D. Handling: Protect materials during handling and application to prevent damage or contamination.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with project requirements, provide products and equipment by the following:
 1. Advanced Blending (817) 477-8022 www.advancedblending.com
 2. Ameripolish, Inc. (800) 592-9320 www.ameripolish.com
 3. Brulin & Company (800) 776-7941 www.brulin.com
 4. Concrete Polishing Solutions (877) 472-8200 www.go2cps.com
 5. Onyx Environmental Solutions (800) 858-3533 www.onyxolutions.com
 6. Pioneer Eclipse (800) 367-3550 www.pioneer-eclipse.com
 7. Prosoco (800) 255-4255 www.prosoco.com
 8. SASE Company, Inc. (800) 522-2606 www.sasecompany.com
 9. Substrate Technology, Inc. (815) 941-4800 www.substratetechnology.com
 10. Superabrasive, Inc., (800) 987-8403, <http://www.superabrasive.com/>
 11. Superior Surface Solutions, (888) 471-5227 www.superiorsurfacesolutions.com
- B. Substitutions: Comply with the requirements of Section 01600.

2.2 EQUIPMENT

- A. Auto Scrubber Machines: Equipment used for cleaning operations shall be Clark Encore Max38 or L38 with a head pressure of 150 lbs. or similar equipment as required to achieve the specified Finish Requirements.
- B. Propane Polishing Equipment:
 - 1. Propane polishing machines shall be in full operating condition during the duration of the night's work as required to achieve specified Finish Requirements.
 - 2. Polishers shall have minimum 450 pounds down force.
- C. Diamond Segments:
 - 1. Diamond grinding heads shall be by one of the following manufacturers. Use heads from same manufacturer throughout entirety of project.
 - a. HTC.
 - b. SASE, Inc.
 - c. Substrate Technology, Inc.
 - d. Superabrasive, Inc.
 - e. Superior Surface Solutions.
 - 2. Diamond Segment Grit Sizes (or Manufacturer's Equivalent Designations):
 - a. Hybrid Style Diamonds: 100 and 200
 - b. Resin Bonded, Phenolic Diamonds: Progression of all polishing steps shall include sequential grit sizes that are not greater than twice the previous grit used.
- D. High speed propane burnisher: Equipment shall meet the specified minimum performance requirements.
 - 1. Head Size: 21 or 27 inch.
 - 2. Head Weight: 22 pound (40 pound maximum).
 - 3. Engine Size: 585 cc, generating 1,500 RPM or higher (as verified with tachometer).
 - 4. Dust skirt assembly.
- E. Burnishing Pads:
 - 1. Diamond Impregnated Pads (DIP): 1500 and 3000 grit.
 - 2. Dimashine Diamond Impregnated Pad by Superior Surface Solutions
 - 3. CASH Diamond Impregnated Pad by Substrate Technology, Inc.

2.3 PRODUCTS

- A. Joint Filler Products:
 - 1. Polyurea joint filler as specified in Section 07900.
 - a. Color: Match polished slab surface. Sample installed in mock-up shall be approved by Owner's Construction Manager.
- B. High pH Cleaner:
 - 1. Amodet Degreaser/Cleaner, by Advanced Blending.
 - 2. Brulin Deep Scrub Cleaner, by Brulin & Co.
 - 3. Cleaner/Degreaser, by Prosoco.
- C. Reactive Surface Densifier: Chemical densifier specifically for concrete surface treatment which reacts chemically to the concrete surface forming a clear, dense, durable, hard, abrasion-resistant surface. Product shall be a colorless, odorless, water-based solution that is less than 50 VOC.
 - 1. Provide one of the following:
 - a. 3D HS Densifier, by Ameripolish, Inc
 - b. SFS D2, by SASE Company
- D. Penetrating Stain Protector:
 - 1. Concrete stain protector specifically for concrete surface treatment which reacts chemically
 - 2. to the concrete surface maintaining a clear, dense, durable, hard, abrasion-resistant surface.
 - 3. Product shall be a solution that is less than 10 g/L VOC.

- a. SR2, by Ameripolish, Inc.
 - 1) Temporary Substitution: Provide [SR2 Plus](#) by Ameripolish as an acceptable substitution for any application of SR2 specified within the scope of this Section if Suppliers indicate SR2 is unavailable.
- b. SFS SPR3, by SASE Company

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine concrete slab with Owner's Construction Manager. Verify that floor is in substantially the same condition as described in the Floor Polishing Plan.
 - 1. Identify and mark additional repair locations not shown in Floor Polishing Plan.

3.2 PREPARATION

- A. Close areas to traffic during and after floor finish application for time period recommended by product manufacturer(s).
- B. Cover and protect merchandise and racking to prevent damage or contamination of stored products. Protect merchandise from concrete slurry or debris.
- C. Clean Substrate:
 - 1. Do not use hazardous materials or flammable, toxic, or solvent-based cleaning products.
 - 2. Remove curing or sealing compounds, paint, and wax.
 - 3. Remove surface contaminants such as oil, grease and general soiling with high pH cleaner/degreaser diluted as recommended by manufacturer using swing machine with red or black pads. Use appropriate pad to achieve desired results while not exposing coarse aggregate or excessive sand within paste layer.
 - 4. Thoroughly rinse floor surface with clean water to remove soap residue and contaminants. Vacuum with auto scrubber.
 - 5. Squeegee dry.
- D. Remove and replace deficient joint filler within the limits of required slab polishing and as shown on Drawings.
- E. Repair slab defects within the limits of required slab polishing.
- F. Verify concrete floors are free of excessive moisture and dusting.
- G. Verify that surfaces conform to the manufacturers' requirements for substrate conditions Do not proceed until unsatisfactory conditions are corrected.

3.3 GENERAL REQUIREMENTS

- A. Complete joint replacement and slab repair work at least 12 hours prior to commencement of any wet polishing.
- B. Use sequential progression of diamond pads limited to no more than double the grit value of the previous diamonds used.
- C. Allow concrete slab to achieve its 28 day design strength as documented by Owner' CTL. Approved compressive strength test report from CTL must be received by Owner's Construction Manager.
- D. Progressively wet diamond polish edges along and around all abutments. Use same progression of polishing segments throughout.
- E. Between and after final wet polishing passes, thoroughly scrub and rinse slab surface with clean water and vacuum with auto-scrubber.

3.4 DENSIFICATION & STAIN PROTECTION

- A. Areas to be treated: Provide Densification where shown on Drawings.
- B. Open slab surface by wet polishing with resin-bonded or hybrid, phenolic diamond heads.
 - 1. Perform initial polishing step and all polishing steps utilizing 200-grit and below twice at minimum.
 - 2. After completion of the above polishing steps, progressively wet polish slab surface.
 - 3. Overlap adjacent passes by 50%.
 - 4. Final polishing pass shall be with no less than 800-grit resin.
- C. Apply reactive surface densifier to dry slab surface after appropriate diamond polishing step, in accordance with manufacturer's instructions.
 - 1. Failure to consult with reactive surface densifier for proper dilution rate required to match adjacent concrete slab panels may result in additional cost to Contractor without an increase in Contract time.
 - 2. Apply reactive surface densifier one time after the appropriate polishing pass (typically after 200-grit and before 800-grit).
 - 3. Manufacturer's recommended application rate 400-600 SqFt per gallon and a minimum 20 minute dwell time.
 - 4. Densifier is to be back wiped utilizing the recommended micro-fiber pads and allow to dry.
 - 5. Polish slab surface in compliance with specified Finish Requirements.
 - 6. Use microfiber pad after burnishing to remove any laitance and debris from slab surface.
- D. Apply penetrating stain protector: Apply penetrating stain protector per manufacturer's recommendations. Allow to cure.

3.5 FINISH REQUIREMENTS:

- A. Appearance: Enhanced interior slabs areas that receive the specified slab enhancement process must consist of the following:
 - 1. Failure to comply with specifications to produce finish requirements may result in additional cost to Contractor without an increase in Contract time or additional disruption to Facility operations.
 - 2. Slab surface must have a consistent look and exhibit a hard polished appearance with no evidence of scratching from grinding/polishing.
 - 3. Exposure of aggregate beyond CPAA Class B - Fine Aggregate shall be considered non-conforming work.
 - 4. White residue, "orange peel", or hazy appearance in the finished surface will not be accepted.
- B. Gloss: Final surface gloss within Facility shall be between 30 and 55 as measured using a Horiba IG-320 Gloss Checker.
- C. Leave work complete and ready for final inspection by Owner's Construction Manager.

3.6 FIELD QUALITY CONTROL TESTING

- A. Gloss Measurements:
 - 1. Gloss shall be considered as a quantitative value that expresses the degree of reflection when light hits the concrete floor surface.
 - 2. Take gloss measurements independent of ambient lighting and within a sealed measurement window located beneath the testing equipment.
 - 3. Measure and report as follows:
 - a. Measure gloss values at five evenly but randomly distributed locations within each aisle for each night's work area. Record measurement locations on Floor Polishing Plan.
 - b. If samples fail to meet the specified value, continue burnishing operations until the specified gloss requirements are achieved.
 - c. Collect and certify final gloss measurements to Owner's Construction Manager and the Owner's Independent Concrete Consultant.

3.7 CLEANING

- A. Remove spilled, splashed, or splattered finish material from surfaces.

3.8 FINAL CLEANING AND PROTECTION

- A. Protect areas to receive polished concrete finish at all times during construction to prevent oils, dirt, metal, excessive water, paint, and other potentially damaging materials from contacting the finished concrete surface. Initiate the following protective measures immediately after completion of the polishing work as specified herein.
 - 1. Communicate to Facility Manager and all subcontractors, vendors, and trades the importance of maintaining slab protection.
 - 2. Protect slab surface from moisture for 24 hours.
 - 3. Each day, inspect equipment used over completed slab surface. Verify the following:
 - a. Equipment is without leaking hydraulic lines and is diapered to avoid staining. Remove all equipment with hydraulic fluid leaks from Facility site.
 - b. Equipment is without tire embedments (rocks, nails, screws, etc.) that will scratch or pit slab surface.
 - c. Equipment is clean and free of dust prior to start of work requiring equipment.
 - 4. Do not allow pipe cutting on the finished slab.
 - 5. Do not place steel on the finished slab to avoid rust staining.
 - 6. Prevent contact with acids and acidic detergents.
 - 7. Use breathable drop cloths during all painting. Immediately wipe clean spilled paint.
- B. Damage to finished slab resulting from lack of protection shall be repaired at no additional cost to Owner.

END OF SECTION

SECTION 03410 (03 4110) - PLANT-PRECAST STRUCTURAL CONCRETE PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Precast, prestressed, insulated structural concrete wall panels.
 2. Precast, prestressed, non-insulated structural concrete wall panels.
 3. Precast, prestressed, structural concrete columns.
- B. Related Requirements:
1. Section 05090 - Post-Installed Concrete and Masonry Anchors.
 2. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
1. ASTM A 36 - Carbon Structural Steel.
 2. ASTM A 82 - Steel Wire, Plain, for Concrete Reinforcement
 3. ASTM A 185 - Steel Welded Wire, Plain, for Concrete Reinforcement.
 4. ASTM A 416 - Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 5. ASTM A 497 - Steel Wire, Deformed for Concrete Reinforcement.
 6. ASTM A 615 - Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 7. ASTM C 33 - Concrete Aggregates.
 8. ASTM C 150 - Portland Cement.
 9. ASTM C 260 - Air-Entraining Admixtures for Concrete.
 10. ASTM C 330 - Lightweight Aggregates for Structural Concrete.
 11. ASTM C 494 - Chemical Admixtures for Concrete.
- C. American Concrete Institute (ACI):
1. ACI 211.1 - Standard Practice for Selecting proportions for Normal, Heavyweight and Mass Concrete.
 2. ACI 306.1 - Cold Weather Concreting.
 3. ACI 318 - Building Code Requirements for Structural Concrete.
- D. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M 251 - Plain and Laminated Elastomeric Bridge Bearings.
- E. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code - Steel.
- F. Precast / Prestressed Concrete Institute (PCI):
1. PCI MNL 116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 2. PCI MNL 120 - Design Handbook - Precast and Prestressed Concrete.
 3. PCI MNL 124 - Design for Fire Resistance of Precast Prestressed Concrete
 4. PCI MNL 135 - Tolerance Manual for Precast and Prestressed Concrete Construction.
- G. National Precast Concrete Association (NPCA):
1. NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

1.3 SUBMITTALS

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- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330. Submit all submittals electronically in PDF format via email, unless otherwise specified, to Architect of Record and Structural Engineer of Record.
- B. Shop Drawings:
 - 1. Plans, elevations, and details indicating panel locations, design loads, construction (including reinforcement, welding requirements, finish, and openings), anchorage, etc. Identify material provided by the manufacturer.
 - 2. Connection reactions where the EOR is responsible for the design of the main building support structure.
 - 3. Shop drawings shall be signed and sealed by a Structural Engineer licensed in the state in which the project is located.
- C. Product Design Criteria: Submit design load calculations signed and sealed by Structural Engineer experienced in precast, prestressed concrete design and licensed in the state in which the project is located.
 - 1. Initial handling and erection stresses, including transportation stresses.
 - 2. Dead, live, wind, and seismic loads as identified in Contract Documents and as required by applicable codes.
- D. Product Data: Submit design load calculations signed and sealed by Structural Engineer experienced in precast, prestressed concrete design and licensed in the state in which the project is located.
 - 1. Mix Designs
 - 2. Admixtures
 - 3. Erection Tolerance
 - 4. Grout
- E. Test Reports: Test reports on concrete and other materials used in fabrication. Do not submit reports but maintain reports on file to be available upon request.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: The manufacturer's precast concrete manufacturing plant shall be certified by either NPCA or PCI Plant Certification Program prior to the start of production. Manufacturer shall have produced product similar to what is specified for a minimum of two years.
- B. Erector's Qualifications:
 - 1. Regularly engaged for a minimum of five years in the erection of precast structural concrete similar to the requirements of this project.
 - 2. Employed by the Manufacturer.
- C. Welders' Qualifications:
 - 1. Certified in accordance with AWS D1.1.
 - 2. Employed by the Manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Support panels during shipment on non-staining shock-absorbing material in same position as during storage.
- C. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible and units can be inspected.
- D. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.

- E. Lift and support units only at designated points shown on Shop Drawings.

1.6 SITE CONDITIONS

- A. Environmental Requirements (Cold Weather): Comply with ACI 306.1 procedures for cold-weather concrete placement.
- B. Environmental Requirements (Hot Weather): Comply with PCI MNL 116 procedures for hot-weather concrete placement.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE WALL PANEL MANUFACTURER

- A. **CTU PRECAST**; 1260 Furneaux Rd, Olivehurst, CA 95961. www.ctuprecast.com

2.2 WALL PANELS

- A. Precast, Prestressed Concrete Wall Panels, locations as noted on the architectural drawings:
 - 1. Wall Panel Types:
 - a. 12 ½” thick insulated panels – 2 ½” exterior wythe, 2” insulation, and 8” interior structural wythe.
 - b. 10 ½” thick insulated panels – 2 ½” exterior wythe, 2” insulation, and 6” interior structural wythe.
 - c. 10” thick non-insulated panels
 - d. 6” thick non-insulated panels

2.3 DESIGN CRITERIA AND REGULATORY REQUIREMENTS

- A. Comply with the design recommendations in NPCA or PCI MNL 120. Comply with applicable building codes and ACI 318.
- B. Calculated Fire-Test-Response Characteristics: Provide architectural precast concrete units with fire-resistance rating indicated as calculated according to PCI MNL 124 and acceptable to authorities having jurisdiction.

2.4 MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III of same type, brand and source.
- B. Admixtures:
 - 1. Air-entraining admixtures: ASTM C 260.
 - 2. Water reducing, retarding, accelerating, high-range water reducing admixtures: ASTM C 494.
 - 3. Fly ash as required by the manufacturer but not less than 10% of total cementitious material.
- C. Aggregates: ASTM C33 or C 330.
- D. Water: Potable and free of foreign materials in amounts harmful to concrete, aggregate, or imbedded steel.
- E. Steel Reinforcing:
 - 1. Reinforcing Bars: Deformed Billet Steel: ASTM A 615.
 - 2. Wire: Cold-Drawn Steel: ASTM A 82.
 - 3. Wire Fabric:
 - a. Welded Steel: ASTM A 185.
 - b. Welded Deformed Steel: ASTM A 497.
- F. Strand: Uncoated, 7-wire, stress relieved or low relaxation steel strand: ASTM A 416 (including supplement) Grade 250K or 270K.
- G. Anchors and Inserts: Structural steel, ASTM A 36, manufacturer’s standard finish .

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- H. Wythe Connectors: Use one manufacturer for the project using one of the following types:
 1. Polypropylene.
 2. Fiber Composite.
- I. Rigid Insulation: Expanded polystyrene board insulation.
- J. Bearing Pads: Elastomeric pads as recommended by precast concrete fabricator for application and the following:
 1. AASHTO M 251, plain, vulcanized, 100% polychloroprene (neoprene) elastomer.
 2. Molded to size or cut from molded sheet.
 3. 50 - 70 Shore, Type A durometer hardness, ASTM D 2240.
 4. Minimum tensile strength 2250 psi, ASTM D 412.
- K. Sand-Cement Grout:
 1. Portland Cement: ASTM C 150, Type I.
 2. Clean, natural sand: ASTM C 144 or ASTM C 404.
- L. Premixed Grout: SikaGrout-212 by Sika Corporation, (800) 933-7452 or (201) 933-8800.
One component ready mix grout.
- M. Joint Sealant: [Sikaflex 2c](#) NS by Sika Corporation, (800) 933-7452 or (201) 933-8800.
 1. Color to match adjacent precast concrete wall panel color.
- N. Fire Stopping Material:
 1. Provide one of the following:
 - a. Ultra Block by [Backer Rod Manufacturing, Inc.](#), (800) 595 2950 or (303) 308 0363. Mechanical expansion and construction joint fire stopping system consisting of a pre-engineered fiberglass roll material with a fiberglass matt facing containing unexpanded vermiculite.
 - b. Metacaulk Joint Strip by [Rectorseal](#) (800) 231-3345. Intumescent firestop material.
 2. Rating as indicated on the Drawings.
- O. Substitutions: Comply with the requirements of Section 01600.

2.5 CONCRETE MIXES

- A. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide concrete with the following properties:
 1. Compressive Strength: 6000 psi min. at 28 days.
 2. Release Strength: 3500 psi min.
 3. Calcium chloride, chloride ions, and/or other salts are not permitted.
 4. Entrained Air: As determined by supplier.
- B. Color Formulation:
 1. Natural grey concrete.
 2. No color additives.

2.6 GROUT MIXES

- A. Mix Ratios:
 1. Site-mixed: Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
 2. Pre-mixed: Per manufacturer's recommendations.

2.7 FABRICATION

- A. Manufacturing procedures shall be in general compliance with either NPCA or PCI MNL 116.

- B. Manufacturing tolerances shall comply with either NPCA or PCI plant certification for structural products.-Comply with camber and dimensional tolerances of NPCA or PCI MNL 135.
- C. Finishes:
1. Standard Underside: Backside of panel or interior face.
 - a. Provide finish produced by casting against approved forms using good industry practice in cleaning forms, design of concrete mix, placing and curing.
 - b. Small surface holes caused by air bubbles, normal color variation, normal form joints, minor chips and spalls shall be tolerated. No major or unsightly imperfections, honeycombs or other defects shall be permitted unless they are nonstructural in nature and are patched as approved by Owner.
 2. Standard Top: Exterior or exposed to view face (Architectural Finish):
 - a. Extent of finishes as indicated on the Drawings.
 - b. Match Architect's samples.
 - c. Provide finish resulting from vibratory screed and additional hand finishing.
 - d. Normal color variation, minor indentations, minor chips and spalls shall be permitted. No major imperfections, honeycombs or defects shall be permitted.
- D. Openings:
1. Plant Fabricate openings 14 inches round or square and larger as indicated on Drawings. Field cut openings smaller than 14 inches.
 2. Insulation held back 3 ½" at all perimeter of all opening locations.
- E. Patching:
1. Maintain structural integrity.
 2. Conform to panel fabricator's recommendations and directions.
 3. Patching of surfaces to receive paint shall be non-discernible in texture, although color may vary, when viewed at a distance of 20 feet in normal light.
 4. Patching of finished surfaces such as exposed aggregates shall be non-discernible in both texture and color when viewed at a distance of 20 feet in normal light.
- F. Fasteners: Cast in structural inserts, bolts, and plates as indicated on Drawings and Shop Drawings.
- G. Insulation: Place full length of panel and space across panel width between reinforcing strands.
- H. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.
- I. Cure concrete according to requirements in PCI MNL 116 by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

2.8 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Manufacturer shall test and inspect precast concrete according to either NPCA or PCI MNL 116 requirements.
- B. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range unless repairs meet requirements in PCI MNL 116. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval..

PART 3 - EXECUTION

3.1 PREPARATION (BY GENERAL CONTRACTOR)

- A. Provide suitable access to and around building with proper drainage and firm, level bearing for hauling and erection equipment to operate under its own power. Provide stable and drainable 40-foot wide all-weather aggregate surfacing to remain in place throughout panel erection. Coordinate with precast manufacturer for location.
- B. Provide true, level bearing surfaces on field placed bearing walls and other field placed bearing structures. Ensure that bearing surfaces are clean and ready for precast panel installation.
- C. Place and align anchor bolts, plates or dowels in column footings, grade beams and other field placed bearing structures.
- D. Install permanent control points for location of panels. Control points shall be at corners and gridlines and not less than 40 feet on center.

3.2 INSTALLATION

- A. Lift panels by means of suitable lifting devices at points provided by the manufacturer.
 - 1. Provide temporary shoring and bracing, if necessary, in compliance with the manufacturer's recommendations, applicable building codes, and PCI or NPCA design requirements. Temporary bracing design shall be signed and sealed by Structural Engineer licensed in the state in which the project is located.
- B. Seal joints between the precast panels and install fire stopping material as shown or as required in joints or openings in fire rated construction. Install in compliance with manufacturer's instructions and recommendations.
- C. Field Welding: Perform field welding by certified welders in accordance with AWS D1.1 using equipment and materials compatible to the base material.
- D. Round or square openings less than 14 inches in size, round or square, shall be located and field drilled or cut by the trade requiring the opening after the panels have been erected unless indicated otherwise on the Drawings. Coordinate with the precast concrete panel fabricator to locate field cut openings to avoid unnecessary cutting of panel reinforcement. Field cut openings shall be verified by the manufacturer to maintain structural integrity of the work.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.5 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 03410).

3.6 CLEANING AND PROTECTION

- A. Clean mortar, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

- B. Comply with manufacturer's instructions and recommendations for cleaning precast concrete panels when panel erection is complete. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Remove weld marks, other markings, dirt and stains.
- C. Protect adjacent work from staining or damage due to cleaning operations.

END OF SECTION

SECTION 03905 – INTERIOR CONCRETE SLAB REPAIRS AND JOINT FILLER REPLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joint filler removal and replacement.
 - 2. Joint edge spall repair.
 - 3. Crack repair.
 - 4. Surface defect repair, including pop-outs, chips, spalls, and pitting.
 - 5. Removal and replacement of previously completed repairs not in compliance with this section.

- B. Related Requirements:
 - 1. Section 01330 – Submittal Procedures. Procedures for submittals.
 - 2. Section 01351 - Regulatory Compliance: Waste management and disposal.
 - 1) Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 - 3. Section 01500 – Temporary Facilities and Controls. Requirements for control of substances that have the potential for polluting surface and/or groundwater.
 - 4. Section 01700 – Execution Requirements. Requirements for use of fuel powered equipment within the enclosed building.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

- B. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

- B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

1.4 SUBMITTALS

- A. Within 21 days after award of prime contract, submit in accordance with procedures specified in Section 01330. Unless otherwise specified herein, send submittals to Architect of Record as specified in Section 01330.
 - 1. Submit all submittal items required within this section in a single submittal via e-mail (maximum document size 10 Mb).
 - a. Do not submit submittals of this section together with submittals in any other section.
 - 2. If Contractor fails to submit a complete Concrete Slab Enhancement Submittal Package within 21 days after award of prime contract, the Contractor shall pay the Owner \$250.00 per day as liquidated damages and not as a penalty, until the fully completed Concrete Slab Enhancement submittal package is received by the Architect of Record.
 - 3. Submittals shall be complete, accurate, and in full compliance with contract requirements for proper and timely approval.
 - 4. Maintain one copy of approved documents on site.
 - 5. Identify submittals explicitly in accordance with Section 01330.
 - 6. Fill out and submit attached Concrete Slab Repair and Joint Filler Replacement Submittal Form attached at the end of this Section.

- B. Submittal Rejections:
1. Submittals which do not comply with Contract Documents will be rejected. If submittal is rejected for any reason, Wal-Mart Stores, Inc., will back-charge the Contractor \$200.00 via Change Order, to cover the processing costs of each subsequent review until submittal is approved. Reasons for submittal rejections include, but are not limited to, the following:
 - a. Incomplete Concrete Slab Enhancement Submittal Package.
 - b. Lack of required certifications.
 - c. Unspecified equipment.
 - d. Unspecified products.
 2. Rejected submittals shall be revised and resubmitted until approved. Extension of Contract time will not be allowed for rejected submittals.
 - a. The Contractor shall revise and resubmit rejected submittals within 7 days of receipt of rejected submittals.
 - b. The Contractor shall verify that the Slab Enhancement subcontractor has addressed all required revisions in the re-submittal.
- C. Product data and Material Safety Data Sheets (MSDS):
1. All products and primary equipment used for repair of existing concrete slab defects.
- D. Joint Filler and Slab Repair Subcontractor Requirements:
1. Joint Filler and Slab Repair Subcontractor Qualifications: Provide to General Contractor for submittal a list of minimum of 5 projects performed within the last 2 years of similar type, size and complexity as this contract. Provide project names, addresses, contact names, phone numbers, and scope of work for each project at time of Bid and within Slab Enhancement Submittal Package.
 2. Joint Filler and Slab Repair Subcontractor shall be a contractor possessing current certifications at time of Bid.
 - a. Joint filler installation and slab repair shall be performed by same subcontractor.
 - b. Joint filler and slab repair subcontractor personnel shall remain the same throughout the completion of specified work unless approved in writing by Owner.
 - c. Joint Filler and Slab Repair Subcontractor shall not sub-subcontract any work in this Section.
 3. Joint Filler and Slab Repair Subcontractor Certifications: Provide to General Contractor for submittal a letter of certification, identifying individuals that are currently certified installers of the following specified materials and are familiar with proper procedures and installation methods as required by the specified product manufacturers.
 - a. Polyurea Joint Filler.
 - b. Low Viscosity Rigid Urethane.

1.5 QUALITY ASSURANCE

- A. Environmental Requirements:
1. Comply with the requirements of Section 01351 for construction and demolition waste management and disposal.
 2. Comply with current Federal, state and local air quality regulations and with Federal requirements on concrete silica dust emissions. Do not dry grind or polish slab surface.
 3. Limit and control all noise and damage from excessive dust caused by demolition, preparation, and installation of specified work.
 4. Limit and control damage from moisture.
 5. Refer to Section 01500 for control of substances that have the potential for polluting surface and/or groundwater.
 6. All replaced concrete shall be cured a minimum of 28 days prior to joint filler installation.
 7. Close finished slab area to traffic during application and after application for a time as recommended by manufacturer.
 8. Upon completion of densifier application, dispose of excess materials. Refer to Section 01351.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Subject to compliance with project requirements, provide products as manufactured by the following to the extent as specified hereinafter:
1. Advanced Blending (817) 477-8022 www.advancedblending.com
 2. Brulin & Company (800) 776-7941 www.brulin.com
 3. Hi-Tech Structural Epoxy Systems (800) 454-5530 www.hitechpolyurea.com
 4. Metzger/McGuire (800) 223-6680 www.metzgermcguire.com
 5. Prime Resins, (800) 321-7212 www.primeresins.com
 6. Prosoco (866) 363-4567 www.prosoco.com
 7. Roadware, Inc. (800) 522-7623 www.concretemender.com
 8. SpecChem (866) 791-8700 www.specchemllc.com
 9. Superior Surface Solutions (888) 471-5227 www.superiorsurfacesolutions.com
 10. VersaFlex, Inc. (913) 321-1416 www.versaflex.com
- B. Polyurea Joint Filler: Rapid setting, two-component polyurea polymer liquid of 100% solids content, Shore hardness 85-90, compatible with construction materials in contact.
1. HT-PE85, High-Tech
 2. EP 80, by Metzger/McGuire.
 3. VersaFlex SL/85, by VersaFlex.
 4. Match color of adjacent exposed concrete slab surface.
- C. Structural Urethane (low viscosity):
1. 10 Minute Concrete Mender, by Roadware
 2. Spall TX, by High Tech
 3. Rapid ReFloor, by Metzger/McGuire.
 4. Quick Mender, by VersaFlex.
 5. Match color of adjacent exposed concrete slab surface.
- D. Silica Sand
1. Dry 00 Sandblasting sand.
- E. Structural Mortar
1. Armor-Hard Extreme, by Metzger/McGuire.
 2. Dimakrete Polish Mortar, by Superior Surface Solutions.
 3. RepCon 928, by SpecChem.
- F. Surface Pitting Grout
1. Dimakrete Polish Grout, by Superior Surface Solutions.
 2. Quick MenderX.O., by VersaFlex.
 3. Rapid ReFloor Pit Grout, by Metzger/McGuire.
 4. Approved equal
- G. High pH Cleaner:
1. Amodet Degreaser/Cleaner by Advanced Blending.
 2. Brulin Deep Scrub Cleaner by Brulin & Co.
 3. Cleaner/Degreaser by Prosoco.
 4. Equivalent approved products.

2.2 EQUIPMENT

- A. Refer to Section 01700 for requirements related to acceptable power sources specified herein.
- B. Subject to compliance with project requirements, provide equipment manufactured by the following:
1. Gator Finishing Products (800) 2554748, www.gatorfinishing.com

2. HTC (877) 482-8700, www.htc-america.com
 3. Joe Due Blades and Equipment, Mauston, WI, (877) 563-3833.
 4. Norton Abrasives (800) 331-3604, www.nortonabrasives.com
 5. Pullman-Ermator (800) 232-2635, www.pullman-ermator.com
 6. SASE Company, Inc., Kent, WA (800) 522-2606
 7. U.S. Saws, Santa Ana, CA (866) 987-7297.
 8. [OBHC, Inc. dba Gorilla Concrete Tools](http://www.obhc.com), Columbia Station, OH, (440) 236-5112.
- C. Dust Collection Vacuum System: Connect one of the following dust collection systems directly to each tool. Verify that collection system provided is equipped with HEPA-rated filter and is recommended by the manufacturer to maintain dust emissions below the permissible level. Verify air flow speed is acceptable for the size of the blade.
1. 26D, by HTC.
 2. S2400, by Pullman-Ermator.
 3. Bull 50, by SASE Company, Inc.
 4. Similar equipment as required to produce the specified results.
- D. Joint Filler Removal and Preparation
1. Humpback Cutter Complete, by Joe Due.
 2. Dust Buggy, by U.S. Saws.
 3. [Gorilla Concrete Tools](http://www.gorillaconcrete.com) GCT-10 or GCT-9 Silverback by OBHC, Inc.
 4. Similar equipment as required to produce the specified results.
- E. Crack Repair:
1. 5" Dust Mizer 005, by Joe Due.
 2. 7" Dust Mizer 007, by Joe Due.
 3. Crack Attacker, by Joe Due.
 4. 7" Handheld Crack Chaser, by Joe Due.
 5. SawTec 5" Tile Vac, by U.S. Saws.
 6. SawTec 7" Crac-Vac, by U.S.Saws.
 7. Similar equipment as required to produce the specified results.
- F. Surface Grinder: Handheld 5"-7" electric surface grinder with dustless shroud/housing.
1. Dust Avenger 5, by Joe Due.
 2. Dust Avenger 7, by Joe Due.
 3. SawTec 5" Grinder Vac, by U.S. Saws.
 4. SawTec 7" Grinder Vac, by U.S. Saws.
 5. Similar equipment as required to produce the specified results.
- G. Fiber Stripping Pads
1. Rapid Strip Disc, by Norton
 2. Gator Fiber Disc, by Gator Finishing Products
 3. Similar equipment as required to produce the specified results.

PART 3 - EXECUTION

3.1 GENERAL

- A. Concrete rehabilitation work specified shall be performed within the limits of the area of the Facility floor shown on Drawings.
- B. Installation of specified products shall be in accordance with product manufacturer's written instructions.
- C. Verify that sawing and grinding tools are equipped with a dust collection system as specified herein.
- D. For repairs of this Section requiring clean joints of loose concrete, joint filler, laitance, dust, and debris, use a HEPA-rated filter vacuum.

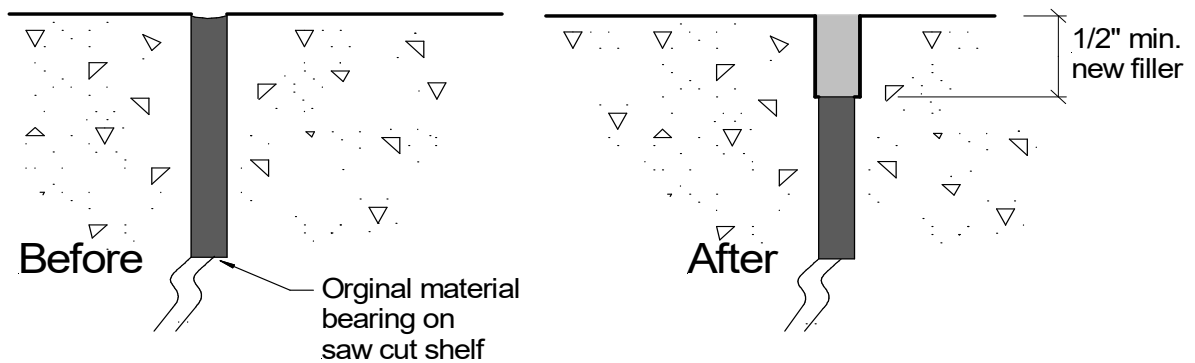
3.2 EXAMINATION

- A. An evaluation of the existing floor slab shall be conducted, identifying all defects. Scope of repairs shall be confirmed by the Owner Concrete Consultant prior to commencement of work. Identify scope of work on Floor Polishing Plan specified in other section(s) of Division 3 – Concrete.
- B. Repairs are not acceptable unless specifically approved on a case-by-case basis by the Owner Construction Testing Laboratory.

3.3 PREPARATION

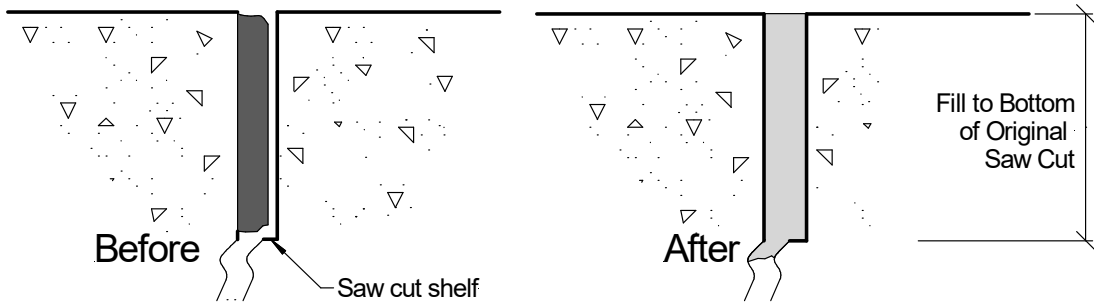
- A. Close areas to traffic during and after floor finish application for time period recommended by product manufacturer(s).
- B. Cover and protect merchandise and racking to prevent damage or contamination of stored products. Provide dust drapes as required to protect merchandise from dust or debris.
- C. Protect surface of slab immediately adjacent to defect under repair.
- D. Do not proceed until Owner Construction Manager has approved repair material color match.

3.4 JOINT MILLING AND CAP FILLER REPLACEMENT



- A. If existing joint filler is sound and resting on top of saw cut shelf, mill top 1/2" of material and refill with specified polyurea joint filler:
- B. Re-saw the joint to a minimum depth of 1/2" with a dry-cut, vacuum-equipped saw using a slightly oversized blade. The blade width should be sufficient to encapsulate the widest spall along a given contraction joint segment to produce a sharp corner on each side of the joint with a minimum of two passes through the joint.
- C. Refill with polyurea joint filler material from the bottom up, taking care not to entrap large air bubbles per manufacturer's recommendation. Slightly overfill and shave flush to the surface, prior to grinding process.
- D. Ensure that after grinding, the joint is cut smooth and flush with the finish floor surface, without concave or intermittent, darkened profile.

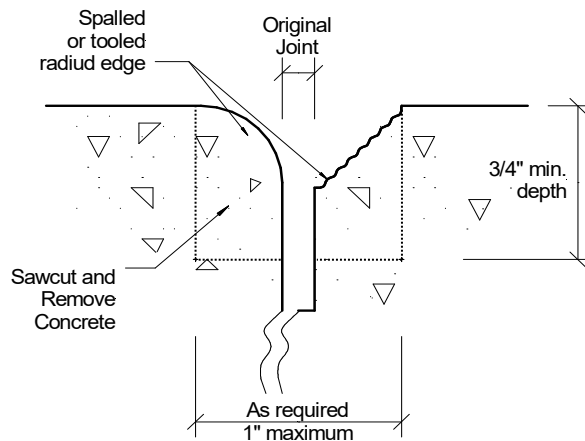
3.5 FULL DEPTH JOINT FILLER REPLACEMENT



Note: if shelf width at base of saw cut is less than 1/4" on either side of joint, minimum required filler depth is 2" placed over compressibel backer rod or bagged silica sand.

- A. If existing joint filler is loose, easily removed, or able to be forced downward with a hand tool, remove all filler material from joint and refill.
- B. Re-saw joint full depth with a dry-cut, vacuum-equipped saw using a slightly oversized blade. The blade width should be sufficient to encapsulate the widest spall along a given contraction joint segment to produce a sharp corner on each side of the joint with a minimum of two passes through the joint. Remove all filler material, debris, and laitance.
- C. If shelf width at base of saw cut is less than 1/4 inch on either side of joint, fill joint with compressible backer rod to not more than 2 inches below slab surface.
- D. Refill with polyurea joint filler material from the bottom up, taking care not to entrap large air bubbles per manufacturer's recommendation. Slightly overfill and shave flush to the surface prior to grinding process.
- E. Ensure that after grinding, the joint is cut smooth and flush with the finish floor surface, without concave or intermittent, darkened profile.

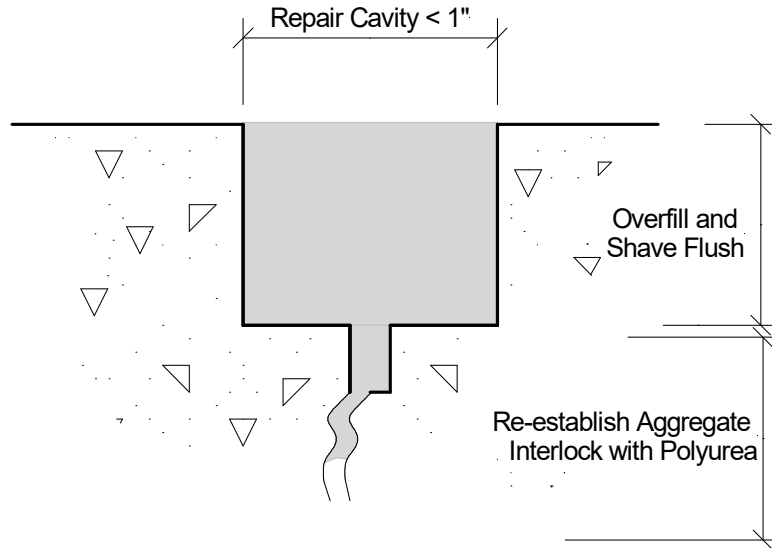
3.6 CONTROL JOINT REPAIR (LESS THAN 1")



- A. For joints that are spalled or have radius tooled edges not exceeding 1" in width at slab surface.
- B. Re-saw the joint edge to a minimum depth of 3/4" with a dry-cut, vacuum-equipped saw allowing removal of the widest spall (or top of radius) along a given joint segment to produce a sharp corner on each side of the joint with a minimum of two passes through joint.

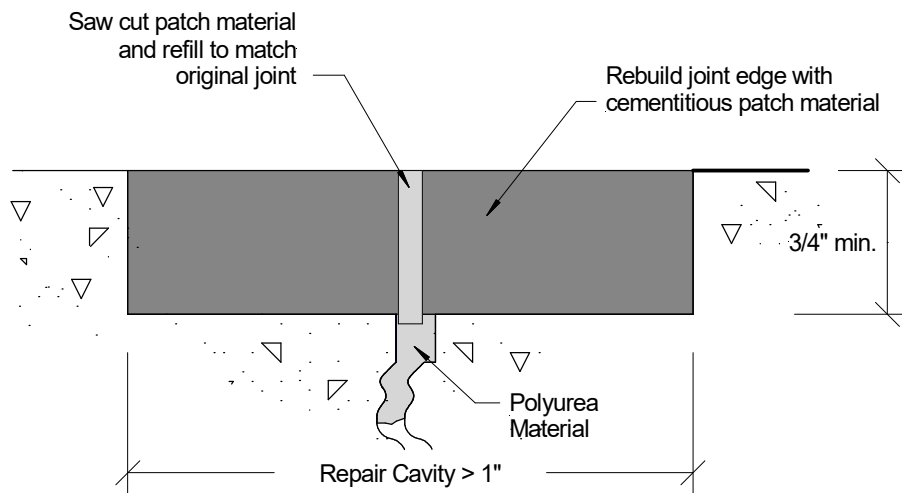
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- C. Clean joint of loose concrete, joint filler, laitance, dirt, debris, backer rod, etc.
- D. Joints must be free of all visible moisture.
- E. Ensure filler penetrates the irregular aggregate interlock portion of the sawn contraction joint as shown below, re-establishing the aggregate interlock that may have been lost due to shrinkage, curling, and lack of reinforcement.



- F. Gravity feed a trace amount (1/8") of silica sand into joint to prevent 3-sided bonding of joint filler. Use proper dust control methods in handling silica sand.
- G. Fill joint cavity per manufacturer's instructions, taking care not to entrap large air bubbles. Overfill joint slightly and shave flush to slab surface prior to grinding process.

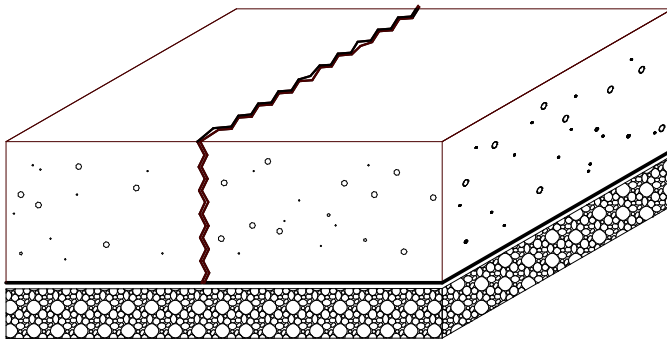
3.7 CONTROL JOINT REPAIR (GREATER THAN 1")



- A. For control joints that exceed 1" in width at slab surface or where the slab displays height differential greater than 1/4" at either side of joint.

- B. Re-saw the control joint edge to a minimum depth of 3/4" with a dry-cut, vacuum-equipped saw allowing removal of the widest spall along a given joint segment to produce a sharp corner on each side of the joint with a minimum of two passes through joint. Maintain consistent width of repair to within 1/2 inch in 10 feet.
 - 1. For construction joints experiencing 1/4" or greater height differential at abutting joint edges, repair material should slope at 1/4" per foot at floor surface.
- C. Acceptable Patch Materials
 - 1. Structural Mortar installed in accordance with manufacturer's recommendations.
 - 2. Sand Modified Structural Urethane:
 - a. Place 1/2" layers of dry Silica Sand in bottom of spalled cavity.
 - b. Pour structural urethane material over sand until sand is slightly covered.
 - c. Repeat 1/2" blended layers of sand and structural urethane material until slightly overfilled above finished concrete surface.
- D. Allow patch material to dry (drying time will vary based on temperature).
- E. Overfill repair cavity with patch material per manufacturer's instructions and grind flush to slab surface.
- F. Use hand grinder with Fiber Stripping Pad to hone over -fill level to adjacent slab surface.
- G. After patch material has cured, and prior to any traffic on patched surface, re-saw original slab joint(s) and fill with polyurea joint filler per manufacturer's instructions.
- H. Polish or burnish repair material to match adjacent slab surface after material has properly cured.

3.8 CRACK REPAIR

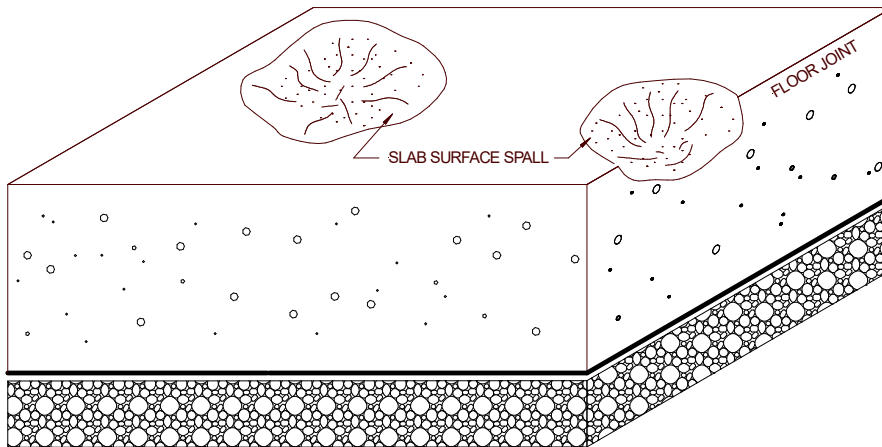


- A. Crack width less than 1/32" without surface spalling.
 - 1. Do not repair.
- B. Cracks from 1/32" to 3/8" in width.
 - 1. Clean crack cavity.
 - a. Remove loose concrete, dirt and debris from crack with a wire brush or hand grinder with twisted wire wheel attachment, 1/2" minimum depth, insuring crack sidewall is clean.
 - b. Remove any loose segments, including islands formed by crack, with sharp tool.
 - c. Use methods that will not widen existing crack.
 - d. Vacuum crack to remove all dirt, debris and other laitance.
 - 2. Mask slab surface along crack as necessary to minimize overfill.
 - 3. Choose material color that closely matches the adjacent floor.
 - 4. Install low viscosity rigid urethane repair material in accordance with manufacturer's instructions.
 - 5. Repeat until all voids are filled and material crowns slab surface.
 - a. Do not flood area around crack.
 - b. Watch for bubble formation and out gassing.
 - c. Do not allow material to gel before adding additional material.
 - 6. Shave or grind material flush to surface as stipulated by manufacturer.

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- C. Cracks from 3/8" to 1" in width
1. Saw top or edge of crack to provide square edge, minimum 3/4" in depth.
 - a. Use small hand grinder with maximum 5" diameter blade, minimizing eventual crack width while maintaining uniformity of shape.
 2. Clean crack cavity.
 - a. Vacuum crack to remove all dirt, debris and other laitance.
 - b. Remove all visible moisture.
 3. Mask slab surface along crack as necessary to minimize overfill.
 4. Install polyurea joint filler.
 - a. Dispense sample into small bucket to test blending of material.
 - b. Prime crack with repair material.
 - c. Dispense material, dragging dispenser tip along crack, until it flows over the slab.
 5. Wait approximately 10 minutes, periodically checking for material cure.
 - a. Check condition of material by shaving with razor scraper.
 - b. Material will shave smooth when cured.
 - c. Proper timing is crucial.
 - 1) Too long and material will be difficult to shave
 - 2) Too soon and material will ravel.
 6. Shave material flush to slab surface per manufacturer's instructions.

3.9 SURFACE SPALLING REPAIR



- A. Route edge of spall to provide 1/2" deep square edge.
 1. Use small hand grinder with maximum 5" diameter dry diamond blade and vacuum system attachment.
 2. Do not overcut slots into existing slab surface.
- B. Clean and prep spalled cavity.
 1. Wire brush spalled surface to remove all dirt and laitance.
 2. Mask slab at perimeter of spall with tape.
- C. Install low viscosity rigid urethane repair material using tube cartridge without flow restrictor.
- D. Polish over repair area with diamond disks to blend surface.
 1. Feather filler material into the adjacent concrete floor surface.
 2. With 2000 grit disk and firm pressure, add a few burn marks to mottle surface to blend with adjacent floor surface.
- E. NOTE: For spalled joints, a form material may be needed to temporarily support vertical face of spalled joint edge. Ensure that the repair material will not adhere to the form.

3.10 BOLT HOLE/SPALL REPAIR

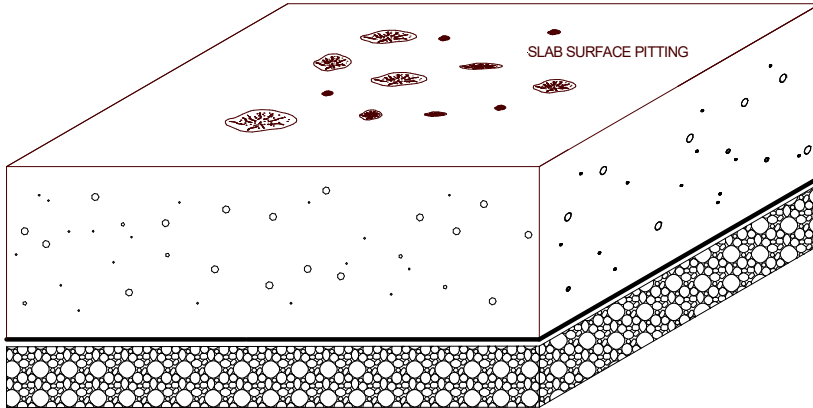
- A. Recess steel bolt a minimum of 1/2" below finish floor by either punching or cutting.
- B. For spall fracture edge less than 30 degrees, square edge to a minimum 3/8" depth with either a drill bit or chisel.
- C. For surface spalls resulting from removal of transition strips, use hollow core drill bit to remove surrounding concrete spall to nominal depth of 1/2". Adjacent repairs shall be of a consistent diameter (max repair size 1" nominal).
- D. Clean cavity of all debris and laitance with drill activated, brass wire wheel. Vacuum hole to remove all dirt, debris and other laitance.
- E. Dispense low viscosity rigid urethane at moderate pace using steady pressure. Dispense material into void, refilling as necessary to produce slight crown.
- F. Grind material flush to slab surface per manufacturer's instructions.

3.11 LARGE SURFACE REPAIR

- A. Edge perimeter with diamond masonry wheel to produce sharp edge, at least 3/8" deep.
- B. Roughen base surface and vacuum clean. Wire brush to remove any small loose material and vacuum again.
- C. Protect adjacent slab surface with tape at perimeter of repair area, width as required to prevent scratching during troweling operations.
- D. Mist floor surface until damp but without standing water.
- E. Prepare slurry prime coat of polymerized Portland cement compound and scrub into repair surface with stiff bristle brush. Do not allow to dry before placing pigmented repair material. Use of concrete bonding agent optional.
- F. Mix repair material in accordance with manufacturer's instructions.
- G. Place repair material in floor surface defect and float level. Use float on edge as using flat will cause material to stick and pull.
- H. Lightly mist floated repair material with the finishing aid once and perform first troweling pass to smooth surface without over-working; do not reapply finishing aid during any other troweling operations.
- I. Wait until material begins to set and can be indented with finger about 1/8" and perform second troweling pass, approximately two hours after initial placement.
- J. Using a fine sharp edged cutting tool, cut along edge of repair material and adjacent slab to prevent raveling of edge during tape removal, or remove tape earlier before material has set up all the way to prevent raveling or spalling.
- K. When material has become stiff and can be slightly indented with hard finger pressure, final trowel using firm pressure until mottling and a shine has become apparent. Surface should be tight, level and smooth without surface defects. Do not allow trowels to be positioned on surface flat, as surface will tear. Use circular sweeping motions. Final set should be around 4-5 hrs from time of placement.
- L. Keep surface clean during troweling operations to prevent any laitance from coming in contact with the repair material and marring surface.
- M. Check material set after 30 minutes to 1 hour. Surface should not dent with fingernail under hard hand pressure.
- N. Dye and polish or burnish repair material to match adjacent slab surface color after material has properly cured.

- O. Remove tape and clean area of all particles on repair surface and adjacent floor surface.
- P. Re-establish original concrete slab joints by sawing completely through patch and re-filling with polyurea joint filler prior to exposure to traffic.

3.12 SURFACE PITTING REPAIR



- A. This repair is to be used in areas where the number of minimum 1/4" size diameter slab pits exceeds eight per square foot.
- B. Using high pH cleaner, scrub slab surface using swing machine with stiff brush, to loosen ground in soils in all pits.
- C. Rinse slab surface with clean water and vacuum up with auto scrubber.
- D. Use specified "Surface Pitting Grout" material after first grind.
- E. Follow manufacturer's instructions regarding procedures.
- F. Repeat repairs in areas as required if repair material pulls out of defects. Allowing a longer curing time typically minimizes material pull out.

3.13 PROTECTION

- A. Protect surfaces of finished floor.
- B. Prohibit traffic until floor repairs have received final approval by Owner.

3.14 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements.

END OF SECTION

SUPPLY CHAIN FACILITIES

INTERIOR CONCRETE SLAB REPAIR AND JOINT FILLER REPLACEMENT SUBMITTAL FORM
Section 03905 – INTERIOR CONCRETE SLAB REPAIRS AND JOINT FILLER REPLACEMENT

Date _____

SUPPLY CHAIN FACILITY INFORMATION

FACILITY # _____
ADDRESS _____
CITY, ST _____
GENERAL CONTRACTOR _____
JOINT FILLER AND SLAB REPAIR _____
SUB-CONTRACTOR _____
JOBSITE PHONE _____

A. **ATTACHMENTS:** Include the following with this Submittal Package.

- Completed Interior Concrete Slab Repair and Joint Filler Replacement Qualification Statement of Conformance.
 - Letter of Certification for Joint and Slab Repair Material and Installation.
 - Product data.
 - Manufacturer and model of all equipment used relating to scope of work.
 - Anticipated Slab Enhancement Floor Polish Plan (Developed from Sheet A1.1) for the following:
 - Anticipated start and finish date of work.
 - Size, location and anticipated progression of individual nightly work areas, forecasted two weeks out from the current date of submittal.
 - Location of all joint filler replacement, cracks, spalls and other surface defects requiring repairs specified herein.
 - Electrical supply locations.
-

INTERIOR CONCRETE SLAB REPAIR AND JOINT FILLER REPLACEMENT QUALIFICATION STATEMENT OF CONFORMANCE
SECTION 03905

Project Location: _____ Date: _____

Project Number: _____ Facility Number: _____

By signing below as approved, the Contractor hereby confirms that the qualifications of the joint filler and slab repair subcontractor conforms to the qualifications as follows:

The joint filler and slab repair subcontractor has experience in finishing interior floors of similar size and scope in at least 5 previous projects. Projects name and location are identified as follows

1. _____
2. _____
3. _____
4. _____
5. _____

Concrete Joint Filler and Slab Repair Subcontractor Company Name and Address:

Signature of Responsible Officer: _____

Typed Name and Title of Officer: _____

Telephone Number: (_____) _____

General Contractor Company Name and Address:

Signed by: _____ Date: _____

Submit one copy of this Statement to the Architect of Record.

SECTION 05090 (05 0900) – POST-INSTALLED CONCRETE AND MASONRY ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-installed mechanical and adhesive type anchors for detailed structural connections and exterior signage.
2. Post-installed general use anchors not included in the above.

B. Related Requirements:

1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
2. Appendix B – Testing, Inspection and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Occupational Safety and Health Administration (OSHA):
 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.
- B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

1.4 SUBMITTALS

- A. Code approval reports showing evidence of published performance data for each structural anchor used shall be available for review by the Structural Engineer of Record (SER) or Architect of Record (AOR) upon request. Evidence may be in the form of current ICC-ESR report of UES-ER report, as noted below, or a report by an independent testing laboratory.
- B. Reports are not necessary for general use anchors, unless required by AHJ.

1.5 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 1. ASTM C 881 - Epoxy-Resin-Based Bonding Systems for Concrete

1.6 QUALITY ASSURANCE

- A. Reports showing evidence of published performance data for each anchor used shall be available for review by the Structural Engineer of Record upon request. Evidence may be in the form of current ICC-ER report or a report by an independent testing laboratory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from one of the following manufacturers:
 - 1. Hilti, Inc. (800) 879-8000
 - 2. ITW Red Head (800) 899-7890
 - 3. Simpson Strong Tie Co. Inc. (800) 999-5099
 - 4. DeWalt/Powers Fasteners, Inc (800) 524-3244

2.2 MATERIALS

- A. Substitutions: Substitutions of products from manufacturers not listed are not permitted.
- B. Alternate Products: Alternate products from the manufacturers listed may be used upon approval based upon suitability for the installation involved as determined by the Structural Engineer of Record.
- C. Provide proprietary anchor products as specified below unless otherwise shown on the drawings or specified in other sections. Anchors may be any one of the products listed for the type specified unless otherwise shown or specified.
- D. Manufacturer's Instructions: Provide complete installation instructions with items furnished to the field.

2.3 STRUCTURAL MECHANICAL ANCHORS

- A. Interior Use Anchors: Zinc plated carbon steel anchors.
- B. Exterior Use Anchors: Stainless steel with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
- C. Wedge Expansion Anchors: Torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Type and size as indicated on Drawings. Provide one of the following:
 - 1. Hilti:
 - a. Kwik Bolt 3.
 - 1) Grout Filled CMU (ESR 1385)
 - b. Kwik Bolt TZ.
 - 1) Concrete (ESR 1917)
 - 2) Grout Filled CMU (ESR 3785)
 - 2. ITW Red Head:
 - a. Trubolt+.
 - 1) Concrete (ESR 2427)
 - 3. DeWalt/Powers:
 - a. Power-Stud.+ SD1
 - 1) Concrete (ESR 2818)
 - 2) Grout Filled CMU (ESR 2966)
 - 4. Simpson:
 - a. Wedge All.
 - 1) Grout Filled CMU (ESR 1396)
 - b. Strong-Bolt 2
 - 1) Concrete (ESR 3037)
 - 2) Grout Filled CMU (ER 240)
- D. Sleeve Anchors: Torque controlled, exhibiting follow-up expansion under load, with provision for rotation prevention during installation. Provide one of the following:
 - 1. Hilti: HLC Sleeve Anchor.
 - a. Exterior signage connections only.
- E. Screw Anchors: Single piece anchor installed in a pre-drilled hole using a bit matching manufacturer tolerances. Anchors shall have 360-degree contact with the base material and shall not require oversized or undersized holes for installation. Provide one of the following:
 - 1. Hilti:

- a. KH-EZ
 - 1) Concrete (ESR 3027)
 - 2) Grout Filled CMU (ESR 3056)
- 2. ITW:
 - a. Tapcon+
 - 1) Concrete (ESR 3699)
 - b. Large Diameter Tapcon (LDT).
 - 1) Shelving fixture upright connection only.
- 3. DeWalt/Powers
 - a. Screw-Bolt+
 - 1) Concrete (ESR 3889)
 - b. Tapper+
 - 1) Grout Filled CMU (ESR 3196)
- 4. Simpson
 - a. Titen HD
 - 1) Concrete (ESR 2713)
 - 2) Grout Filled CMU (ESR 1056)

2.4 STRUCTURAL ADHESIVE ANCHORS

- A. Adhesive Anchor Bolts: Stud-type anchors consisting of threaded steel rod, nut, and washer or deformed reinforcing bar, and anchor adhesive. Use type and size as indicated on Drawings. Use stainless steel or zinc coated carbon steel for exterior exposure.
- B. Adhesive: Adhesive shall be a cartridge type, two-component, epoxy, acrylic, or hybrid based system dispensed and mixed through a static mixing nozzle supplied by the manufacturer. Acceptable installation and performance temperature ranges shall be verified with manufacturer's literature prior to installation. Provide one of the following:
 - 1. Hilti:
 - a. HIT-HY 200 (A/R)
 - 1) Concrete (ESR 3187)
 - 2) Grout Filled CMU (ESR 3963)
 - b. HIT-HY 70
 - 1) Hollow and Grout Filled CMU (ESR 2682)
 - c. HIT-RE 500 V3
 - 1) Concrete (ESR 3814)
 - 2. Simpson:
 - a. SET-XP
 - 1) Concrete (ESR 2508)
 - 2) Grout Filled CMU (ER 265)
 - b. AT-XP
 - 1) Concrete (ER263)
 - 2) Grout Filled CMU (ER 281)
 - 3. ITW Red Head:
 - a. Epcon C6+
 - 1) Concrete (ESR 3577)
 - b. Epcon A7+
 - 1) Concrete (ESR 3908)
 - 2) Grout Filled CMU (ESR 3200)
 - 4. DeWalt/Powers:
 - a. AC100+ Gold
 - 1) Concrete (ESR 2582)
 - 2) Grout Filled CMU (ESR 3200)
 - b. AC200+
 - 1) Concrete (ESR 4027)

2.5 GENERAL USE ANCHORS

- A. General use anchors shall be adequate for the loads they support.
- B. Testing and inspection are not required for general use anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and adjacent areas where products and materials will be installed and verify that conditions conform to product manufacturer's requirements. Verify that structural components are ready to receive Work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of installation indicates acceptance of existing conditions.

3.2 INSTALLATION

- A. Post-installed anchors installed for missing or misplaced cast-in-place anchors shall be approved by the Structural Engineer of Record.
- B. Where manufacturer recommends use of special tools for installation of anchors, such tools shall be used, unless otherwise permitted specifically by the Structural Engineer of Record.
- C. Where holes are drilled in concrete or masonry, provide drills equipped with a HEPA-rated filter vacuum dust collection system recommended by the manufacturer to maintain dust emissions below the permissible level.
- D. Drill holes accurately and squarely and. Clean holes in accordance with the manufacturer's recommendations using HEPA-rated filter vacuum.
- E. Post-installed Anchor Installation (General):
 - 1. Install post-installed anchors where shown on the drawings.
 - 2. Perform anchor installation in accordance with manufacturer instructions. Install anchors at not less than the minimum embedment, edge distance, and spacing recommended by the manufacturer.
 - 3. Drill holes with rotary impact hammer drills using carbide-tipped bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the base material surface.
 - a. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
 - b. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Avoid damage to existing reinforcing or embedded items during coring or drilling. Avoid damaging electrical and telecommunications conduit and gas lines. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling.
 - c. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - d. Hollow Substrates: Where anchors are noted to be installed in hollow substrates, holes shall be drilled using rotation mode only.
 - 4. Use anchors of the same anchor manufacturer for anchors of the same type.
- F. Mechanical Anchor Installation: Protect threads from damage during anchor installation. Sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench.
- G. Adhesive Anchor Installation:
 - 1. When the base material temperature drops below 40-degrees F, use only acrylic adhesive. See manufacturer's instructions for additional minimum temperature requirements. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install under environmental conditions outside manufacturer's absolute limits.
 - 2. Hollow Substrates: Anchorage into hollow substrates is not allowed unless specifically indicated on the contract documents. Where applicable, the adhesive manufacturer's screen tubes shall be used for

- adhesive installation into hollow substrate applications.
3. Oversized Holes: Refer to manufacturer's information if drilled hole size is larger than what is recommended.
 4. Core Drilled Holes: Refer to manufacturer's information if holes are drilled with a core-drill bit.
 5. Clean holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

3.3 REPAIR OF DEFECTIVE WORK

- A. Remove and replace misplaced, defective, or malfunctioning anchors. Anchors that fail a sheer or pullout test, if directed or installation torque requirements shall be regarded as malfunctioning. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout.

3.4 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not preclude Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.5 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 05090).

END OF SECTION

SECTION 05120 (05 1200) - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Structural steel framing members, structural steel support members, struts, with required bracing, welds, and fasteners shown on the structural drawings.
 2. Structural steel columns.
 3. Base plates and headed shear stud connectors.
 4. Anchor bolts required for items included in this Section.
 5. Steel plates and angles shown on the structural drawings with anchor studs, sleeve anchors, expansion bolts, or adhesive anchors, which are embedded in or cast into concrete or masonry.
 6. Teflon coated slide bearing pads.
 7. Grout, for setting and anchoring items in masonry and concrete.
 8. Secondary structural framing for support of insulated metal panels.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
1. Section 03300 - Concrete: Anchorages cast in concrete.
 2. Section 03410 – Plant Precast Structural Concrete Panels: Attachments to precast panels.
 3. Section 05090 - Post-Installed Concrete and Masonry Anchors: Mechanical and adhesive type anchor studs, expansion bolts, sleeve anchors, adhesive anchors, and anchor bolts embedded in concrete and masonry for anchoring and supporting structural members.
 4. Section 05300 - Metal Deck: Support framing for floor or roof openings.
 5. Section 05500 - Metal Fabrications: Miscellaneous steel components.
 6. Appendix B – Testing, Inspection and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Institute of Steel Construction (AISC):
1. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
 2. AISC 360 - Structural Steel Buildings.
- C. ASTM International (ASTM):
1. ASTM A 36 - Structural Steel.
 2. ASTM A 53 - Pipe, Steel, Black and Galvanized, Seamless and Welded.
 3. ASTM A 108 - Steel Bars, Carbon And Alloy, Cold- Finished,
 4. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 5. ASTM A 307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 6. ASTM A 325 - Structural Bolts, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 7. ASTM A 490 - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
 8. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 9. ASTM A 501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 10. ASTM A 992 - Structural Steel Shapes.
 11. ASTM C 1107 - Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
 12. ASTM D 1187 - Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 13. ASTM E 709 - Standard Guide for Magnetic Particle Testing

- D. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code.
 - 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- E. Research Council on Structural Connections (RCSC):
 - 1. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
- F. Steel Structures Painting Council (SSPC):
 - 1. SSPC-SP 2 - Hand Tool Cleaning.
 - 2. SSPC SP-3 – Power Tool Cleaning.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting:
 - 1. Convene Pre-installation Meeting at Site one week prior to commencing work of this Section. Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, Contractor, steel erector sub-contractor and foreman, and Owner's Construction Testing Laboratory.
 - 2. Notify all attendees at least two weeks prior to the meeting.
 - 3. Review preparation and installation procedures and coordinating and scheduling required with related work.
 - 4. Review foreseeable methods and procedures related to the work, including the following:
 - a. Tour, inspect, and discuss condition of preparatory work performed by other trades.
 - b. Review structural loading limitations and bracing requirements.
 - c. Review drawings, specifications and other contract documents including submittals.
 - d. Review and finalize construction schedule related to work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Review required inspections, testing, certifying, and material usage accounting procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - 5. Record discussions of the meeting and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending.

1.4 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330. Submit all submittals electronically in PDF format via email, unless otherwise specified, to Architect of Record and Structural Engineer of Record. When available, a 3D file (.ifc or similar) shall be provided to the Architect of Record for reference.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, and fasteners.
 - 2. Include supplementary parts and members necessary to complete structural steel work, regardless of whether parts are definitely shown or specified, and furnish bolts, gussets, plates, and related items as required for proper assembly of items.
 - 3. Include miscellaneous deck support angles as required for proper support of metal deck around columns, gussets, openings, and obstructions.
 - 4. Include profiles, sizes, spacing, and locations of secondary structural members, connections, attachments, and fasteners.
 - 5. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
 - 6. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by other trades.
 - 7. Indicate top of bearing plate elevations, and elevations above finish floor to the centerlines of embedded plate, anchor bolts, and all control joint locations.
 - 8. Templates shall be furnished by fabricator with instructions for setting of anchor bolts and bearing plates.
 - 9. Prepare shop drawings for any structural items designed by the steel supplier under seal of a Professional Structural Engineer registered in the State in which Project is located.

10. Omission from shop drawings of materials required by Contract Documents does not relieve Contractor of responsibility of furnishing and installing such materials even though shop drawings may have been returned and reviewed.
- C. Calculations: Submit design calculations for structural steel connections not detailed on Contract Documents or proposed differently than as shown on Contract Documents, signed and sealed by Professional Structural Engineer registered in State in which Project is located.
- D. Delegated Design Submittal: Secondary Structural Framing
 1. Comply with design loads noted on the construction documents and the performance requirements listed in this specification.
 2. Include calculations signed sealed by the qualified Professional Structural Engineer, registered in the project state, responsible for their preparation.
- E. Primer Finish: Submit standard shop primer samples to Architect and Owner for review and approval.
 1. Type: Sherman Williams STEEL SPEC® 3002 UNIVERSAL PRIMER (B50AS200- Gray)
- F. Substitutions: Submit substitutions of sections or modifications of details, or both, and reasons for proposal, with shop drawings. Clearly identify substitutions as such. Accepted substitutions, modifications, and necessary changes in related portions of Work shall be coordinated by fabricator and shall be accomplished at no additional cost to Owner.

1.5 QUALITY ASSURANCE

- A. Welder Qualifications: Qualify welding operators in accordance with Standard Qualification Procedures as required by AWS D1.1.
- B. Comply with applicable provisions of the following specifications and documents:
 1. AISC 303.
 2. AISC 360.
 3. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
- C. Design connections not detailed on Drawings under direct supervision of a Professional Structural Engineer experienced in the design of this Work registered in State in which the project is located.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery: Structural Steel Supplier will deliver products to Site for Contractor to receive on delivery date established by Contractor.
- B. Product Packaging: Steel will be shipped with identification markings on each component or package. Identification markings will coordinate with identification markings for components indicated on Structural Steel Supplier setting drawings.
- C. Acceptance at Site:
 1. Verify quantity of products furnished with setting drawings and Bills of Lading provided by Structural Steel Supplier.
 2. Report discrepancies in product quantity delivered, or damage to products delivered to Owner's Construction Manager immediately. Note description of product quantity discrepancies and/or product damage on Bill of Lading.
- D. Manufacturing Defects: Report suspected product manufacturing defects to Owner's Construction Manager and the Structural Steel Supplier. Upon notification, Contractor will arrange for repair of product manufacturing defects.
- E. Transport, handle, store, and protect products in accordance with the requirements of Section 01600.

- F. Store materials to permit easy access for inspection and identification.
- G. Keep steel members off ground by using pallets, platforms, or other supports.
- H. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion or damage members or supporting structures.
 - 3. Remove salt residue from steel members by power spraying when present as a result of salted roads during winter weather transport.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel:
 - 1. Wide Flange Steel Shapes: ASTM A 992 or A 572.
 - 2. Steel Channels and Angle Shapes:
 - a. ASTM A 36, Grade 36 as noted on the drawings.
 - b. ASTM A 572, Grade 50 as noted on the drawings
 - 3. Anchor Bolts:
 - a. ASTM F1554, Grade 36 as noted on the drawings.
 - b. ASTM F1554, Grade 55 (S-1), as noted on the drawings.
 - 4. Plates and Bars:
 - a. ASTM A 36, Grade 36 as noted on the drawings.
 - b. ASTM A 572, Grade 50 as noted on the drawings
- B. Hollow Structural Sections:
 - 1. Square and Rectangular HSS Shapes: ASTM A 500, Grade C.
 - 2. Round HSS Shapes: ASTM A 500, Grade C.
- C. Structural Steel Pipe: ASTM A 53, Grade B; ASTM A 500, Grade B; or ASTM A 501 as shown on the drawings.
- D. Secondary Steel Framing:
 - 1. Steel used to form girts, channels and other secondary framing must meet the requirements of ASTM A-1011 or ASTM A-1039 Grade 55 for primed material or ASTM A-653 Grade 55 for galvanized material with a minimum yield of 55 ksi.
 - 1. Steel used to form angles must meet the requirements of ASTM A-1011 or ASTM A-1039 Grade 55 for primed material; ASTM A-653 Grade 55 for galvanized material with a minimum yield of 55 ksi; or ASTM A 1003, Structural Grade, Type H, metallic coated, Grade: ST50H (50 ksi).
 - 2. Design Thicknesses – Gauge to be determined by design to meet specified loading conditions.

2.2 SECONDARY FRAMING

- 1. Girts: Girts shall be cold-formed "Z" sections with stiffened flanges. Flange stiffeners shall be sized to comply with the requirements of the latest edition of AISI and LGSI. They shall be pre-punched to provide for field bolting to the primary structure. They shall be simple or continuous span as required by design. Connection bolts will install through the girt webs, not girt flanges.
 - a. Web Depth: 12"
 - b. Minimum Flange Width: As recommended by insulated metal panel manufacturer.
 - c. Maximum Length: To be determined by design.
- 2. Channels: Cold-formed "C" sections with flanges.
 - a. Web Depth: 12"
 - b. Minimum Flange Width: As recommended by insulated metal panel manufacturer.
 - c. Maximum Length: To be determined by design.

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3. Angles: Cold-formed "L" sections.
 - a. Depth and Width: To be determined by design or as noted on the construction documents.
 - b. Maximum Length: To be determined by design.
4. Finish: Provide one of the following:
 - a. Primed: Sherman Williams STEEL SPEC® 3002 UNIVERSAL PRIMER (B50AS200- Gray)
 - b. Galvanized: Minimum coating G60 or equivalent.

2.3 ACCESSORIES

- A. Bolts, Nuts, and Washers: ASTM A 325 or A 307 as shown on Drawings.
- B. Primer Finish:
 1. Standard shop primer:
 - a. Sherman Williams STEEL SPEC® 3002 UNIVERSAL PRIMER (B50AS200- Gray)
- C. Welding Materials:
 1. AWS D1.1; type required for materials being welded or as shown on Drawings.
 2. E 7024 electrodes ("Jet Weld" rods) are not permitted; use only "All Position" rods. (7018LH)
- D. Headed Stud Anchors: ASTM A 108, Grades 1010 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Adhesive or Mechanical Anchors: Anchors associated with structural steel specified herein shall conform to requirements specified in Section 05090.
- F. Asphaltic Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Teflon Coated Slide Bearing Pads: Provide one of the following products:
 1. Fluorogold by [Seismic Energy Products, LP](#) (formerly Furon), Athens, TX (903) 675-8571.
 2. Dura-Slide by [Tobi Engineering](#), Glenview, IL (847) 724-7880.
 3. Type CSA by [Con-Serv, Inc.](#), Georgetown, SC (843) 546-1044.
- H. Non-Shrink Grout: Pre-mixed non-shrinking, high strength grout, ASTM C 1107, Type A, B, or C; compressive strength of 5,000 psi in 28 days. Provide one of the following products:
 1. [NS Grout](#) by [Euclid Chemical](#), Cleveland, OH (800) 321-7628.
 2. [MasterFlow 100 General Construction Grout](#) by [BASF Building Systems](#).
 3. [Certi-Vex Grout 1000](#) by [Vexcon Chemicals](#), Philadelphia, PA (888) 839-2661.
 4. [1107 Advantage Grout](#) by [Dayton Superior](#), Miamisburg, OH (888) 977-9600.
- I. Framed Openings: Used to frame out doors, windows, louvers, and any other openings. Refers to the framing members and flashing which surround an opening and includes jambs, header and or sill, trim, and fasteners.
- J. Permanent Roof Tie-off Points: Locate where noted on the roof framing plans:
 1. [Kee Rigid Anchor](#) by Kee Safety (716) 896-4949.
 - a. Bolt On Anchors: KRA-BMC
 - b. Galvanized finish to ASTM A123
 - c. Attachment Point: Forged D-Ring
 - d. Height: 8" min above roof, 20" standard total height above top of steel.
 2. Deck Support Plate – Supplied by Steel Supplier
 - a. 1/8"x16"x16" plate placed above steel beam and below anchor plate.
 - b. Pre-drill 13/16" diameter holes in plate, coordinate locations with manufacturer information.

2.4 FABRICATION

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- A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate according to AISC 360.
- B. Do not splice structural steel members unless otherwise shown on Drawings or without written approval from the Structural Engineer of Record.
- C. Secondary Steel Fabrication:
 - 1. Coordinate secondary steel framing required for support of insulated metal panels with structural steel shown on Drawings. Shop fabricate girts and related components complete with connection holes for attachment of primary and secondary framing members.
 - 2. Girts, channels, and miscellaneous steel members required for attachment of the secondary support steel to building structure to be roll formed members complying with ASTM A1008. Design, size, space and install members to meet job and loading conditions. Shop punch members with holes and furnished complete with angle clips and fastenings required for attaching to structure.
 - 3. Bolted Connections: Ribbed or high tensile steel bolts as appropriate for each connection.

2.5 FINISH

- A. Clean, prepare, and shop prime structural steel members.
- B. Do not paint surfaces in contact with concrete, or surfaces specified to be galvanized.
- C. Galvanized Finish: Minimum 1.25 oz/sq ft zinc (hot-dipped galvanized) coating complying with ASTM A 123. Galvanize the following items:
 - 1. Structural steel angles and plates, exposed to weather and/or in contact with or embedded in concrete or masonry.
 - 2. Anchor bolts exposed to weather and in contact with or embedded in concrete or masonry.
- D. Primer Finish: Prepare structural steel items scheduled to receive primer finish by SSPC-SP 2 (Hand Tool Cleaning) method. Prime steel with primer finish specified; minimum dry mil thickness of 2 mils.
 - 1. Apply primer finish to all structural steel items not specified as galvanized on the drawings.
 - 2. Do not apply primer finish to the top of structural steel beams that will receive headed stud anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and adjacent areas where products and materials will be installed and verify that conditions conform to product manufacturer's requirements. Verify elevations of concrete and masonry bearing surfaces and locations of anchorage. Verify that all conditions are ready to receive Work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting diagrams.
- B. Clean surfaces thoroughly prior to installation.
- C. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads equal in intensity to design loads. Remove temporary supports when permanent structural framing connections and bracing are in place, unless otherwise indicated.

3.3 ON-SITE STORAGE

- A. Steel shall be stored off the ground to keep dirt and other debris from collecting on the members.

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3.4 SURVEY

- A. Employ Professional Engineer or Land Surveyor registered in State in which Project is located, experienced in survey work, to establish permanent bench marks as shown and as necessary for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Owner's Construction Manager. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Owner.
 - 1. During erection of the elevated floors, the top of steel elevations shall be measured at the column locations prior to the placement of concrete. Any elevations which exceed allowable tolerances shall be corrected prior to the placement of concrete. If the elevations cannot be corrected with standard field adjustments, and RFI shall be sent to the EOR.

3.5 SECONDARY STEEL FRAMING TOLERANCES

- A. Secondary steel supporting insulated metal panels: Install support members within the following tolerances:
 - 1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.
 - 2. Plus or minus 1/4 inch cumulative in 20 feet in any direction along plane of framing.
 - 3. Plus or minus 1/2 inch from framing plane on any elevation.
 - 4. Plumb or level within 1/8 inch at changes of transverse for preformed corner panel applications.
 - 5. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and horizontal joints of vertical panel systems.

3.6 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Make provision for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members.
- D. Anchor Bolts: Install anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations. Provide post-installed anchors in accordance with Section 05090.
- E. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surfaces of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on adjusting nuts.
 - 2. Tighten anchor bolts after the supported members have been positioned and plumbed.
 - 3. Grout solidly between bearing surfaces and bases of plates. Finish exposed surfaces, protect installed materials, and allow to cure. For proprietary grout materials, comply with manufacturer's installation instructions.
 - 4. Slide Bearing Pads: Permanently affixed to member and support, respectively, by welding or bolting as indicated. Align and level member faces to maintain full contact between surfaces before completing installation.
- F. High-strength Bolting: Install high-strength bolts according to RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts for type of bolt and type of joint shown or specified.
- G. Erection Bolts:
 - 1. Comply with ASTM A 307.
 - 2. Hand tighten nut to minimum depth of nut.
- H. Field Welding: Perform field welding in accordance with AWS D1.1 or D1.3, as applicable.

- I. Touch-up Painting: Immediately after erection, clean exposed field welds, bolted connections, and abraded areas of shop paint and apply touch-up primer to exposed surfaces. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- J. Protective Coating: Field apply heavy coat of asphaltic mastic bituminous coating to anchor bolts, base plates, and columns below finished floor where shown on the drawings.
- K. Field Painting: Specified in Section 09900.
- L. Spray Foam Insulation – If spray foam insulation is used to seal openings prior to the placement of concrete, then all foam shall be removed upon the curing of the concrete. Foam that is exposed to view will not be acceptable.

3.7 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B (Section 05120) shall not preclude Contractor responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.8 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 05120).

3.9 REPAIRS AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting for touching up shop-painted surfaces.
- B. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.10 CLEANING

- A. Clean exposed surfaces of primed or painted erected steel to remove stains, dust, dirt, grease, oil, and other surface contaminants.
- B. The appearance of the steel shall be approved by an Owner's Representative prior to the start of installation for any other trades.

END OF SECTION

SECTION 05300 (05 3000) - METAL DECK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal roof deck.
2. Metal canopy deck.
3. Metal floor deck.
4. Metal platform deck.
5. Metal form deck.
6. Metal deck used for vertical smoke curtains.
7. Metal deck attachments and fasteners.
8. Deck accessories.
9. Installation of metal decking and accessories.

B. Related Requirements:

1. Section 05090 - Post-installed Concrete and Masonry Anchors: Mechanical and adhesive type anchor studs, expansion bolts, sleeve anchors, adhesive anchors, and anchor bolts embedded in concrete and masonry for anchoring and supporting steel deck.
2. Section 05120 - Structural Steel:
 - a. Structural steel for framed openings.
 - b. Support plates and angles.
3. Section 06150 – Mezzanine Deck Panels: ResinDek composite wood panels installed over metal platform deck.
4. Appendix B - Laboratory Testing Services: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Iron and Steel Institute (AISI): Specification for the Design of Cold-Formed Steel Structural Members.
- C. ASTM International (ASTM):
 1. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 2. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- D. American Welding Society (AWS):
 1. AWS D1.1 - Structural Welding Code.
 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- E. Steel Deck Institute (SDI):
 1. ANSI/SDI-RD Standard for Steel Roof Deck (SDI Standard).
 2. ANSI/SDI-NC Standard for Non-Composite Steel Floor Deck (SDI Standard).
 3. ANSI/SDI-C Standard for Composite Steel Floor Deck (SDI Standard).
- F. Steel Structures Painting Council (SSPC):
 1. SSPC SP-2 – Hand Tool Cleaning.
 2. SSPC SP-3 – Power Tool Cleaning.
 3. SSPC-Paint 20 - Zinc-Rich Coating Type I - Inorganic and Type II – Organic.

4. SSPC-Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330. Submit all submittals electronically in PDF format via email, unless otherwise specified, to Architect of Record and Structural Engineer of Record.
- B. Shop Drawings:
 - 1. Shop Drawings shall indicate:
 - a. Decking plan, deck profile dimensions, support type and locations, projections, openings and reinforcements, fastening method and installation accessories.
 - b. Locations, types, and sequence of connections.
 - c. Deck welds by standard welding symbols adopted by AWS.
 - d. Pour stop locations, dimensions, and gauge.
- C. Evaluation Reports: Submit to Architect of Record and Structural Engineer of Record approved hard copy of the most recent IAPMO-UES report.

1.4 QUALITY ASSURANCE

- A. Welder Qualifications: Qualify welding operators in accordance with Standard Qualification Procedures as required by AWS D1.1.
- B. Installer Qualifications: Powder and air actuated fasteners shall be installed by a tool operator licensed by the pin manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Metal Deck Supplier will deliver products to site to be received by Contractor as specified in Section 01600.
- B. Project Packaging: Metal decking will be shipped in manufacturer's standard packaging with identification markings on each component or package. Identification markings will coordinate with identification markings for components indicated on Metal Deck Supplier installation final field use drawings.
- C. Receive and accept owner furnished products and report suspected defects and discrepancies in compliance with the requirements of Section 01600.
- D. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- E. Keep materials dry. Separate sheets and store deck on dry wood sleepers; slope for positive drainage. Protect with a waterproof covering and ventilate to avoid condensation.
- F. Prevent damage to edges, ends, and surfaces.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

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2.2 APPROVED MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Canam United States; Canam Group Inc.
 2. Epic Metals Corporation.
 3. New Millennium Building Systems, LLC.
 4. Nucor Corp.; Vulcraft Group.
 5. Verco Manufacturing Co.
 6. ASC Steel Deck.

2.3 MATERIALS

- A. Metal Deck, General: Conforming to SDI standards, type, metal gage, and depth as shown on Drawings. Fabricate panels to comply with ANSI/SDI standards.

B. ROOF DECK

1. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 50 minimum, G60 zinc coating:
 - a. Deck profile: **DGN-32, roof deck.**
 - b. Profile depth: As indicated on drawings.
 - c. Design uncoated-steel thickness: As indicated on drawings.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Lapped or Butted.**
 - f. Deck sheet sidelap condition: Interlocking seam.
 - g. Primary fasteners: As indicated on drawings.
 - h. Sidelap fasteners: As indicated on drawings.
 - i. Steel primer:
 - 1) Top: Un-primed.
 - 2) Bottom: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.

C. EXTERIOR CANOPY ROOF DECK

1. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 50 minimum, G90 zinc coating:
 - a. Deck profile: **DGN-32, roof deck.**
 - b. Profile depth: As indicated on drawings.
 - c. Design uncoated-steel thickness: As indicated on drawings.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Lapped.**
 - f. Deck sheet sidelap condition: Interlocking seam.
 - g. Primary fasteners: As indicated on drawings.
 - h. Sidelap fasteners: As indicated on drawings.
 - i. Steel primer:
 - 1) Top: Un-primed.
 - 2) Bottom: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.

D. COMPOSITE FLOOR DECK

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1. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 50 minimum, G60 zinc coating:
 - a. Deck profile: **DG2WH-36, composite deck.**
 - b. Profile depth: As indicated on drawings.
 - c. Design uncoated-steel thickness: As indicated on drawings.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Butted.**
 - f. Deck sheet sidelap condition: Interlocking seam.
 - g. Primary fasteners: As indicated on drawings.
 - h. Sidelap fasteners: As indicated on drawings.
 - i. Steel primer:
 - 1) Top: Un-primed.
 - 2) Bottom: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.
- E. PLATFORM DECK (WITH RESINDEK COVERING)
1. Platform Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 50 minimum, G60 zinc coating:
 - a. Deck profile: Deck profile: **DGBH-36, composite deck.**
 - b. Profile depth: As indicated on drawings.
 - c. Design uncoated-steel thickness: As indicated on drawings.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Butted.**
 - f. Deck sheet sidelap condition: Interlocking seam.
 - g. Primary fasteners: As indicated on drawings.
 - h. Sidelap fasteners: As indicated on drawings.
 - i. Steel primer:
 - 1) Top: Un-primed.
 - 2) Bottom: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.
- F. NON-COMPOSITE ROOF DECK
1. Non-Composite Deck: Fabricate panels to comply with "SDI Specifications and Commentary for Non-Composite Steel Deck," in SDI Publication No. 31, and with the following:
 2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 80 minimum, G60 zinc coating:
 - a. Deck profile: **2 ½" corrugated roof deck.**
 - b. Profile depth: As indicated on drawings.
 - c. Design uncoated-steel thickness: As indicated on drawings.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Lapped.**
 - f. Deck sheet sidelap condition: Lapped.
 - g. Primary fasteners: As indicated on drawings.
 - h. Sidelap fasteners: As indicated on drawings.
 - i. Steel primer:
 - 1) Top: Un-primed.
 - 2) Bottom: Un-primed.

G. INTERIOR SMOKE CURTAIN DECK

1. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
2. Galvanized and shop-primed steel sheet: ASTM A 653, Structural Steel (SS), Grade 50 minimum, G60 zinc coating:
 - a. Deck profile: **B-36, roof deck.**
 - b. Profile depth: 1 ½ inches.
 - c. Design uncoated-steel thickness: 0.0295 inches.
 - d. Span condition: Triple span or more.
 - e. Deck sheet end condition: **Lapped.**
 - f. Deck sheet sidelap condition: Lapped.
 - g. Primary fasteners: #12 self-drilling, self-tapping screws at 24" spacing.
 - h. Sidelap fasteners: #10 self-drilling, self-tapping screws at 36" spacing.
 - i. Steel primer:
 - 1) Top: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.
 - 2) Bottom: Cleaned and pretreated surface primed with manufacturer's standard white baked-on, rust-inhibitive primer.
 - j. Installation: Vertical, where noted on architectural drawings.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Welding Materials: AWS D1.1.
- C. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
 1. Screw Support Fasteners: Fasteners as noted on the Structural Drawings.
 - a. Self-drilling, self tapping No. 12 HWH3 Kwik-Seal Fasteners by [Hilti](#), Tulsa, OK (800) 879-8000
 - b. Self-drilling, self tapping No. 12 HWH Tek screws, by [ITW Buildex](#), Itaska, IL (800) 323-0720.
 - c. Self-drilling, self tapping No. 12 IHWH Dril-Flex screws, by [Elco Construction Products](#), Towson, MD (800) 435-7213.
 - d. Self-drilling, self tapping No. 12 HWH X metal screws, by [Simpson Strong Tie](#), Pleasanton, CA (800) 999-5099.
 2. High Capacity Screw Support Fasteners: Fasteners as noted on the Structural Drawings.
 - a. Self-drilling, self tapping No. 12 Strong Drive XL large head metal screws, by [Simpson Strong Tie](#), Pleasanton, CA (800) 999-5099.
 3. Powder Actuated or Air Actuated Support Fasteners: Fasteners as noted on the Structural Drawings.
 - a. X-HSN 24 or X-ENP 19 Powder Actuated Fasteners by [Hilti](#), Tulsa, OK (800) 879-8000
 - b. SDK-61075, SDK-63075 or K66062 Air Actuated Fasteners by [Pneutek, Inc.](#), Hudson, NH (800) 431-8665.
 4. DeltaGrip side seam attachment system: Fasteners as noted on the Structural Drawings.
 - a. 3/8" wide, 60-degree triangular tabs engaging all three layers of standing seam side lap.
 - b. Installed using ASC provided tools.
- D. Side-Lap Fasteners:
 1. Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
 2. Interlocking seam, as noted on drawings.
- E. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- F. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 40,000 psi, not less than

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0.0295-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 40,000 psi, not less than 0.0295-inch design uncoated thickness, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, minimum yield strength of 40,000 psi, not less than 0.0295-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch-thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
 - 1. For shop applied primer: SSPC 25.
 - 2. For galvanized surfaces: SSPC 20.
- K. Concrete Anchorage: Specified in Section 03310.
- L. Post-Installed Anchorage: Specified in Section 05090.
- M. Flashing and Counter Flashing: Specified in Section 07620.
- N. Gutters and Downspouts: Specified in Section 07711.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and adjacent areas where products and materials will be installed and verify that conditions conform to product manufacturer's requirements. Verify that metal deck supporting framing components are ready to receive Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Interface with Other Work:
 - 1. Coordinate locations and sizes of openings for skylights (if specified), smoke vents (if specified), roof top mechanical equipment and any other penetrations of metal deck.
 - 2. Verify steel support spacing, bracing, and layout.
 - 3. Coordinate structural steel support framing for metal deck openings.
- B. Erect metal decking and connect to structure in accordance with SDI standards. Coordinate attachment sequence and procedure with placing of units; show on final field use drawings.
- C. On steel support members provide SDI minimum bearing length.
- D. Align and level deck on supports.
- E. Attach welds, fasteners, and side lap connectors of size, spacing, and location as indicated on Drawings.
- F. Install Hilti powder actuated fasteners using DX 860 HSN, DX 460 SM, DX 860 ENP or DX 76 tools, by Hilti. Installed pin height shall be in accordance with manufacturer's recommendations and verified with manufacturer approved inspection gage. Determine power level by jobsite testing.
- G. Install Pneutek air actuated fasteners using decking system, by Pneutek. Install pins in accordance with manufacturer's recommendations. Pin head shall clamp deck tightly to supporting member without gaps between

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underside of head and top side of deck. Pin shall not cause excessive dimpling of the deck greater than 1/2 the thickness of the pin head.

- H. Welding: In accordance with AWS D1.1 and D1.3. Provide welding washers when welding 24 gauge or lighter steel in conformance with SDI standards. Install 6 inch wide sheet steel cover plates where deck changes direction. Spot weld in place 12 inches on center maximum. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- I. After welding deck in place, touch-up welds, burned areas, and surface coating damage with prime paint.
- J. Smoke Curtains: Attach to building structure as indicated on Drawings. Cut to fit tight around penetrations. Seal gaps at penetrations, around roof deck to curtain, and at walled curtain perimeter.
- K. Metal Canopy Deck:
 - 1. Coordinate with work of other Sections to produce watertight assembly, capable of withstanding loading pressures and thermal and lateral loads.
 - 2. Install gutter and downspouts furnished under other Sections.
 - 3. Lap panels, set into sealant, and fasten at spacing indicated on Drawings.
 - 4. Coat welded connections with zinc-rich primer complying with SSPC-Paint 20.
 - 5. Isolate metals from dissimilar metals or corrosive substrates using bituminous coating.
 - 6. Fill space between metal panel and support beam and between metal panel and light fixtures with pre-molded closure accessory strip to eliminate nesting space for birds.
 - 7. Field Finish: Paint canopy supports, structural steel, metal fabrications and accessories on tops, bottoms, edges, and other weather-exposed surfaces as indicated on Drawings, in accordance with Section 09900.

3.3 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not preclude Contractor responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. Manufacturer's Field Services: Powder and air actuated fasteners.
 - 1. Inspection: Manufacturer's representative (not a distributor or agent) shall be on site to inspect and verify proper installation of 100% of fasteners.
 - 2. Report: Manufacturer representative (not a distributor or agent) shall submit inspection report indicating verification to Owner's Construction Manager.

3.4 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection (T & I) as specified in Appendix B.

3.5 PROTECTION

- A. Preparation for Repair Painting: Promptly after installation, clean and prepare rust spots, welds, and abraded surfaces of prime-painted deck with hand tools according to SSPC-SP 2, or power tools according to SSPC-SP 3.
- B. Final Cleaning:
 - 1. Thoroughly wet wipe or wash exposed surfaces of erected members to remove stains, dust, dirt, grease, oil, and other surface contaminants accumulated during storage or after installation.
 - 2. Do not proceed with repair painting until exposed surfaces are free of dirt and contaminants.
- C. Repair Painting: Apply repair paint of same color as adjacent shop-primed deck to bottom surfaces of deck exposed to view.

END OF SECTION

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SECTION 05400 - COLD FORMED METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior Load-Bearing, Non-Load Bearing, and Shear Wall Cold Formed Framing.
2. Interior Load-Bearing and Shear Wall Cold Formed Framing.
3. Interior Non-Load-Bearing Partition Wall Cold Formed Framing.
4. Floor Joist Cold Formed Framing.
5. Roof Rafter Cold Formed Framing.
6. Ceiling Joist Cold Formed Framing.
7. Cold Formed Framing Connections and Accessories.

B. Related Requirements:

1. Section 05090 - Post-installed Concrete and Masonry Anchors: Mechanical and adhesive anchors drilled into concrete or masonry.
2. Section 05120 - Structural Steel: Structural building framing.
3. Section 05300 - Metal Deck: Structural floor and roof deck.
4. Section 06100 - Rough Carpentry: Wood furring strips, plywood, and blocking.
5. Section 07210 - Building Insulation: Thermal insulation installed in exterior framing.
6. Section 09250 - Gypsum Board: Gypsum Board.
7. Appendix B – Testing, Inspection and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Iron and Steel Institute (AISI):

1. North American Specification for the Design of Cold-Formed Steel Structural Members.
2. Standard for Cold-Formed Steel Framing

C. ASTM International (ASTM):

1. ASTM A 36 - Carbon Structural Steel.
2. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A 1003 - Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
4. ASTM C 955 – Standard Specification for Cold Formed Steel Structural Framing Members.
5. ASTM C 1007 - Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
6. ASTM C 1513 - Steel Tapping Screws for Cold-Formed Steel Framing Connections.

D. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.3 - Structural Welding Code - Steel Sheet.

E. Steel Structures Painting Council (SSPC):

1. SSPC-Paint 20 Type I - Zinc Rich Primers - Inorganic.

F. Steel Framing Industry Association (SFIA):

1. Member listing.

G. Steel Stud Manufacturers Association (SSMA):

1. SSMA Product Technical Information.

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1.3 PRECONSTRUCTION MEETING

- A. Preconstruction Conference: Conduct conference at Project site with the General Contractor, Cold Formed Steel Framing Sub-Contractor, and the Testing Agency prior to the start of field installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following
 1. Cold-formed steel framing materials.
 2. Load-bearing wall framing.
 3. Exterior non-load-bearing wall framing.
 4. Interior non-load-bearing wall framing.
 5. Vertical deflection clips.
 6. Single deflection track.
 7. Double deflection track.
 8. Drift clips.
 9. Post-installed anchors (per section 05090).
 10. Power-actuated anchors.
- B. Evaluation Reports: For cold-formed steel framing.
 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- C. Shop Drawings
 1. Provide Shop Drawings prepared by cold-formed metal framing installer.
 2. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 3. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 4. Shop drawings shall be stamped by a qualified Specialty Structural Engineer (SSE) (SSE) registered in the jurisdiction of the project.
- D. Delegated Design Submittal
 1. Comply with design loads noted on the construction documents and the performance requirements listed in this specification.
 2. Include analysis data and calculations signed sealed by the qualified Specialty Structural Engineer (SSE) (SSE), registered in the project state, responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).
 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
- B. Installer Qualifications: Company specializing in the installation of cold formed metal framing components with minimum five years documented experience.
- C. Qualifications for Welding Work: Qualify welding operators in accordance with Standard Qualification Procedures as required by AWS D1.1.
- D. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.

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- B. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- C. Store and protect metal framing products with waterproof covering; ventilate to avoid condensation.
- D. Where framing is stored outdoors, stack materials off ground, supported on level platform, fully protected from weather.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- 1. [ClarkDietrich](#), West Chester, OH (513) 870-1100.
- 2. [The Steel Network](#), Durham, NC (888) 474-4876.
- 3. [Cemco Steel](#), Ft. Worth, TX (817) 568-1525.
- 4. [Telling Industries, LLC](#) Willoughby, OH (866) 372-6384.
- 5. [Marino/WARE](#), South Plainfield, NJ (800) 627-4661.
- 6. Other manufacturers listed as members of SSMA, or SFIA.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified Specialty Structural Engineer (SSE) (SSE) to design cold-formed steel framing and connections as indicated on the construction documents. The design professional, individual or organization shall have responsibility for the design of the specialty items. This responsibility shall be in accordance with the state's statues and regulations governing the professional registration and certification of architects or engineers.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads:
 - a. Exterior Load-Bearing, Non-Load Bearing, and Shear Wall Framing:
 - 1) Gravity Loads: As indicated on the Structural Drawings.
 - 2) Exterior Wind Loads: Calculated by the SSE based on wind speed and exposure from the Structural Drawings.
 - 3) Seismic Loads: Calculated by the SSE based on seismic site parameters on the Structural Drawings.
 - 4) Shear Wall Loads: As indicated on the Structural Drawings.
 - b. Interior Load-Bearing and Shear Wall Framing:
 - 1) Gravity Loads: As indicated on the Structural Drawings.
 - 2) Interior Wind Loads: 5 psf.
 - 3) Seismic Loads: Calculated by the SSE based on seismic site parameters on the Structural Drawings.
 - 4) Shear Wall Loads: As indicated on the Structural Drawings.
 - c. Interior Non-Load-Bearing Partition Wall Framing:
 - 1) Gravity Loads: Calculated by the SSE, 5 psf minimum.
 - 2) Interior Wind Loads: 5 psf.
 - 3) Seismic Loads: Calculated by the SSE based on seismic site parameters on the Structural Drawings.
 - d. Floor Joist Framing:
 - 1) Gravity Loads: As indicated on the Structural Drawings.
 - e. Roof Rafter Framing:
 - 1) Gravity Loads: As indicated on the Structural Drawings.
 - 2) Exterior Wind Loads: Calculated by the SSE based on wind speed and exposure from the Structural Drawings.
 - 3) Seismic Loads: Calculated by the SSE based on seismic site parameters on the Structural Drawings.
 - f. Ceiling Joist Framing:
 - 1) Gravity Loads: Calculated by the SSE, 5 psf minimum. Where indicated on the Architectural drawings, design ceiling joists for 20 psf roof live load.

- 2) Interior Wind Loads: 5 psf.
 - 3) Seismic Loads: Calculated by the SSE based on seismic site parameters on the Structural Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without horizontal and vertical deflections greater than the following:
 - a. Exterior Load-Bearing, Non-Load Bearing and Shear Wall Framing: Horizontal out-of-plane deflection of 1/240 of the wall height.
 - b. Interior Load-Bearing and Shear Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - c. Interior Non-Load-Bearing Partition Wall Framing: Horizontal out-of-plane deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - d. Floor Joist Framing: Vertical deflection of 1/360 for live loads and 1/240 for total loads of the span.
 - e. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
 - f. Ceiling Joist Framing: Vertical deflection of 1/240 for total loads of the span.
 3. SSE shall design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows, unless noted otherwise on the construction documents:
 - a. Below floor framing: Downward movement of 1 inch (25 mm).
 - b. Below roof framing: Upward and downward movement of 2 inches (51 mm).
 4. SSE shall design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100 and AISI S240.
- E. Fire-Resistance Ratings: Where fire-resistance rating requirements are shown on the Architectural drawings, framing shall comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED FRAMING MATERIALS

- A. Comply with AISI North American Specification for the Design of Cold-Formed Steel Structural Members and AISI Standard for Cold-Formed Steel Framing.
- B. Steel Sheet Minimum Requirements:
1. 22 gauge and 20 gauge (drywall) framing: ASTM A 1003, Structural Grade, Type H, metallic coated, Grade: ST33H (33 ksi), minimum coating G40 or equivalent.
 2. 20 gauge (structural) and 18 gauge framing: ASTM A 1003, Structural Grade, Type H, metallic coated, Grade: ST33H (33 ksi), minimum coating G60 or equivalent.
 3. 16 gauge framing ASTM A 1003, Structural Grade, Type H, metallic coated, Grade: ST50H (50 ksi), minimum coating G60 or equivalent.
- C. Material Thickness & Strength Requirements: Cold formed steel members shall have the following minimum base metal thickness and yield strength:
1. 22 gauge: 27 mils, 33 ksi
 2. 20 gauge (drywall): 30 mils, 33 ksi
 3. 20 gauge (structural): 33 mils, 33 ksi
 4. 18 gauge: 43 mils, 33 ksi
 5. 16 gauge: 54 mils, 50 ksi

2.4 COLD-FORMED FRAMING TYPES

- A. Exterior Load-Bearing, Non-Load Bearing, and Shear Wall Framing:
 - 1. Manufacturer's standard C-shaped steel studs, punched, with stiffened flanges.
 - 2. Web depths as indicated on the Structural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.
- B. Interior Load-Bearing and Shear Wall Framing:
 - 1. Manufacturer's standard C-shaped steel studs, punched, with stiffened flanges.
 - 2. Web depths as indicated on the Structural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.
- C. Interior Non-Load-Bearing Partition Wall Framing:
 - 1. Manufacturer's standard C-shaped steel studs, punched, with stiffened flanges.
 - 2. Web depths as indicated on the Architectural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.
- D. Floor Joist Framing:
 - 1. Manufacturer's standard C-shaped steel joists, unpunched, with stiffened flanges.
 - 2. Web depths as indicated on the Structural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.
- E. Roof Rafter Framing:
 - 1. Manufacturer's standard C-shaped steel rafters, unpunched, with stiffened flanges.
 - 2. Web depths as indicated on the Structural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.
- F. Ceiling Joist Framing:
 - 1. Manufacturer's standard C-shaped steel studs, punched, with stiffened flanges.
 - 2. Web depths as indicated on the Architectural construction documents.
 - 3. Flange width and metal gauge by the Specialty Structural Engineer (SSE) to meet design requirements.
 - 4. Stud spacing by the Specialty Structural Engineer (SSE) to meet design requirements, 16" maximum.
 - 5. Stud bridging type, size and spacing by the Specialty Structural Engineer (SSE) to meet design requirements.

2.5 ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, required by design requirements.
 - 1. Cold-Formed Channels: Minimum 3/4 inch x 1/2 inch.
 - 2. Clip Angles: Minimum 2 inches x 2 inches x 16 gauge x 1/4 inch less than stud width
- C. Framing Attachment Angles: Galvanized sheet steel, size, shape and configuration as indicated on Structural Drawings or delegated design drawings.
- D. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened

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flanges, tight fit; solid web, and same minimum base-metal thickness as steel studs.

- E. Deflection (Capture) Track: Deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth as shown to contain studs while allowing free vertical movement, with flanges or legs as shown designed to support horizontal and lateral loads. Provide fasteners as indicated on Structural Drawings or delegated design drawings.
- F. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure.
- G. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.
- H. Flat Metal Straps and Backing Plates: Galvanized sheet steel, gauge, shape, and configuration as indicated on Structural Drawings or delegated design drawings.

2.6 FASTENERS (minimum performance criteria)

- A. The Specialty Structural Engineer (SSE)'s drawings and design shall include the following anchors, clips and fasteners as required by the design requirements:
 - 1. Steel Shapes and Clips.
 - 2. Shear wall hold-downs.
 - 3. Post-Installed Anchors.
 - 4. Power-Actuated Anchors.
 - 5. Mechanical Fasteners, head type: low-profile head beneath sheathing, manufacturer's standard elsewhere.
 - 6. Welding Electrodes.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load.
- C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
- D. Framing to Framing: ASTM C 1513; 5/8 inch Type S-12 low-profile head corrosion-resistant self-drilling self-tapping steel screws.
- E. Framing to Attachment Structural Steel: #12 diameter pan head corrosion-resistant self-drilling self-tapping steel screws.
- F. Wall Floor Track Anchorage Device: Carbon steel wedge type expansion anchor; minimum 3/8 inch diameter x minimum 1-1/2 inch embedment unless noted otherwise on the Drawings. Refer to Section 05090 for approved anchors.
- G. Wall Furring to Concrete or Masonry Wall Fasteners: Hex head screw anchors; minimum 1/4 inch diameter x minimum 1-1/2 inch embedment into concrete or solid grouted masonry unless otherwise noted on the Drawings. Refer to Section 05090 for approved anchors.
- H. Furring Channel to Masonry or Concrete Surface Fasteners: Low velocity powder-actuated drive pins of size to suit application.
- I. Welding Materials: AWS D1.3.
- J. Wood Furring, Blocking, and Plywood, Attached to Framing Fasteners: Specified in Section 06100.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780, SSPC-Paint 20, Type II - organic.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1
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part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

2.9 SUBSTITUTIONS

- A. Comply with the requirements of Section 01600.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions and adjacent areas where products will be installed and verify that conditions conform to product manufacturer's requirements. Verify that building framing components are ready to receive work. Verify that rough-in utilities are in-place and located where required. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of erection indicates acceptance of existing conditions.

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete

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or masonry construction.

- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION - GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing in accordance with ASTM C1007, AISI S200 North America Standard for Cold-Formed Steel Framing and to manufacturer's written instructions unless more stringent requirements are shown or specified.
- C. Install shop or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
- I. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- J. Install insulation, specified in Section 07210 "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, which are inaccessible on completion of framing work.
- K. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- L. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 INSTALLATION - GENERAL STUD FRAMING

- A. Where optional framing products by the named manufacturers are specified in Part 2 above in lieu of conventional components specified, install in accordance with manufacturers recommendations.

- B. Erect studs one-piece full length. Splicing of studs not permitted.
- C. Erect studs, brace, and reinforce to develop full strength to meet design requirements.
- D. Install studs and fasteners in accordance with manufacturer's published instructions and, where gypsum board is attached to studs, install studs in accordance with GA-216 and ASTM C 1007.
- E. Place studs as indicated on Shop Drawings, minimum 2 inches from abutting walls.
- F. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- G. Align stud web openings horizontally.
- H. Construct corners using minimum three studs.
- I. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated on the shop drawings.
- J. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as indicated on shop drawings.
- K. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- L. Install intermediate studs above and below openings to match wall stud spacing.
- M. Fasten studs adjacent to door and window frames, partition intersections, and corners to top and bottom runner flanges in double-stud fashion with metal lock fastener tools.
 1. Securely fasten studs to jamb and head anchor clips of door and borrowed-light frames.
 2. Place horizontally a cut-to-length section of runner with web-flange bent at each end, fasten with minimum one screw per flange.
 3. Position a cut-to-length stud (extending to top runner) at vertical panel joints over door frame header.
- N. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- O. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- P. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- Q. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing. If type of

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supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

- R. Touch up field welds and damaged galvanized surfaces with galvanizing repair paint.

3.5 INSTALLATION - LOAD BEARING STUD FRAMING

- A. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as indicated on shop drawings.
- B. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- C. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

3.6 INSTALLATION – FLOOR JOISTS

- A. Install joists and fasteners in accordance with manufacturer's published instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Place floor joists at locations and spacing as indicated on the Shop Drawings.
- D. Touch-up field welds and damaged galvanized surfaces with galvanizing repair paint.
- E. Fastening: Indicated on Shop Drawings.
- F. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- G. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing indicated on Shop Drawings.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- H. Space joists not more than 2 inches from abutting walls, and as indicated on Shop Drawings.
- I. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- J. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
 - 1. Install web stiffeners to transfer axial loads of walls above.
 - 2. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as indicated on Shop Drawings.
- K. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- L. Install bridging per the shop drawings.
- M. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION - CEILING JOISTS AND ROOF RAFTERS

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- A. Install joists and fasteners in accordance with manufacturer's published instructions and, where gypsum board is attached to joists, install joists in accordance with ASTM C 1007 and GA-216.
- B. Place ceiling joists or roof rafters at locations and spacing as indicated on the Shop Drawings.
- C. Install joists in direction of shortest span, parallel and level, with lateral bracing and bridging.
- D. Install joists in one-piece full length. Splicing of joists not permitted.
- E. Install perimeter joist runner track sized to match joists. Attach joist runner track to wall framing with minimum two screws per stud and at corners and ends.
- F. Attach joist ends to joist runner tracks with minimum one screw each side at each flange.
- G. Install bridging per the shop drawings.

3.8 INSTALLATION - FURRING

- A. Furring Channels: Attach vertically spaced at maximum 16 inches on center, unless otherwise shown on the drawings, to masonry and concrete surfaces with specified powder driven fasteners staggered 24 inches on center on opposite flanges.
- B. Wall Furring:
 1. Secure top and bottom runners to structure.
 2. Space metal furring at maximum 16 inches on center unless otherwise shown on the drawings.

3.9 INTERFACE WITH OTHER WORK

- A. Coordinate erection of studs with hollow metal door frames and overhead coiling door frames.
- B. Coordinate installation of anchors, supports, and blocking for mechanical, electrical, and building accessory items installed within framing.

3.10 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

3.11 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not preclude Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.12 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 05400).

END OF SECTION

SECTION 05500 (05 50000) - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Shop fabricated ferrous metal items, galvanized and prime painted.
- B. Related Requirements:
 - 1. Section 03310 - Structural Concrete and Exterior Concrete Slabs: Grout for setting metal fabrications.
 - 2. Section 05090 - Post-installed Concrete and Masonry Anchors: Mechanical and adhesive anchors drilled into concrete or masonry.
 - 3. Section 05120 - Structural Steel: Connection of miscellaneous framing and supports to structural steel.
 - 4. Section 06065 - Plastic Materials: Plastic sleeves for steel pipe bollards.
 - 5. Section 09900 - Paints and Coatings: Field painted finishes.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A 14.3 - Ladders, Fixed, Safety Requirements.
- C. ASTM International (ASTM):
 - 1. ASTM A 36 - Carbon Structural Steel.
 - 2. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 3. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A 240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 6. ASTM A 307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 7. ASTM A 325 - Structural Bolts, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 8. ASTM A 500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 9. ASTM A 591 - Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications.
 - 10. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 11. ASTM A 666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 12. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, Baked Hardenable.
 - 13. ASTM A 1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- D. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code.
 - 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- E. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products.
- F. Steel Structures Painting Council (SSPC):
 - 1. SSPC-Paint 20 - Zinc-Rich Coating Type I - Inorganic and Type II - Organic.
 - 2. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand cleaned Steel Type I and Type II.

3. SSPC-SP3 - Power Tool Cleaning
4. SSPC-PA1 - Shop, Field, and Maintenance Painting of Steel.

1.3 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330. Submit all submittals electronically in PDF format via email, unless otherwise specified, to Architect of Record.
- B. Shop Drawings: Submit within 10 working days of Contract Date.
 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 2. Include erection drawings, elevations, and details where applicable.
 3. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
 4. Prepare shop drawings under the supervision of a licensed structural Professional Engineer.

1.4 QUALITY ASSURANCE

- A. Qualifications for Welding Work: Qualify welding operators in accordance with Standard Qualification Procedures as required by AWS D1.1.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery: Supplier will deliver products and equipment to site to be received by Contractor as specified in Section 01600.
- B. Product Packaging: Products will be delivered in manufacturer's standard packaging with identification markings on each component or package.
- C. Receiving: Receive and accept products, verify quantity, and report suspected defects or discrepancies in compliance with the requirements of Section 01600.
- D. Manufacturing Defects: Report suspected manufacturing defects to Owner's Construction Manager and product supplier.
- E. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Plates and Shapes: ASTM A 36.
- B. Bolts, Nuts, and Washers: ASTM A 325 and ASTM A 307.
- C. Cold Rolled Steel Sheet: ASTM A 1008.
- D. Hot Rolled Steel Sheet: ASTM A 1011.
- E. Galvanized Steel Sheets:
 1. Structural: ASTM A 653 Structural Quality;
 - a. Exposed to Weather: G90.
 - b. Not Exposed to Weather: G60.
 2. Galvanized Sheet Steel: ASTM A 591, Class C.
- F. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 304 or 430 as shown or specified.

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- G. Steel Tubing: ASTM A 500, Grade C.
- H. Steel Piping: ASTM A 53.
- I. Welding Materials: AWS D1.1 and AWS D1.3 type required for materials being welded.
- J. Primers:
 1. Shop application and field touch-up: SSPC 25.
 2. Touch-up Primer for Galvanized Surfaces: SSPC 20.
 3. Color: To match primer used on steel roof deck and joists.
- K. Concrete Inserts: Cast steel or malleable bolts, washers, and shims; galvanized.
- L. Grout: Specified in Section 03310.

2.2 FABRICATION

- A. Verify dimensions on site prior to shop fabrication.
- B. Fabricate items with joints tightly fitted and secured.
- C. Fit and shop assemble in largest practical sections, for delivery to site.
- D. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.
- E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- F. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.

2.3 FINISHES

- A. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.
- B. Prime Painting:
 1. Prime paint in shop as scheduled.
 2. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 3. Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
 4. Do not prime surfaces in direct contact bond with concrete or where field welding is required.
 5. Prime paint items scheduled with one coat. Touch up with same primer.
- C. Galvanizing: Hot-dip galvanize items indicated to be galvanized to comply with ASTM A 123 or ASTM A 153 as applicable. Galvanize to minimum 2.0 oz/sq ft zinc coating, exterior items, and those items indicated on Drawings and specified herein, to be galvanized.
- D. Field Finish Painting: Finish paint after installation as shown on Drawings or specified herein in accordance with Section 09900.
- E. Factory Finish Coating: Where specified hereinafter to be factory finished, finish with manufacturer's standard factory finish suitable for the application.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain Owner Construction Manager approval prior to site cutting or making adjustments not scheduled.
- B. Clean and strip site primed steel items to bare metal where site welding is scheduled.
- C. Make provision for erection loads with temporary bracing. Keep work in alignment.
- D. Use grout specified in Section 03310 for setting metal fabrications.

3.2 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Perform field welding in accordance with AWS D1.1 or D1.3, as applicable. After installation, grind sight-exposed field welds smooth, touch-up welds, scratched, or damaged surfaces with primer.
- C. Use grout specified in Section 03310 for setting metal fabrications.

3.3 SCHEDULE

- A. Provide items as scheduled herein and as indicated on Drawings.
- B. Include related items and systems necessary to complete the Work including anchorages and attachments necessary for installation
- C. Concrete or Masonry Loose Bearing Plates and Lintels: Fabricate to sizes and configuration indicated on Drawings; galvanized finish except for items requiring field welding.
- D. Miscellaneous Framing and Supports: Furnish steel framing and supports not specified under Section 05120. Fabricate welded construction in as large units as possible. Drill and tap for hardware and other items. Include anchors required for building into work of other Sections.
 - 1. Interior: Prime paint finish, gray.
 - 2. Exterior: Galvanized.
- E. Rough Hardware: Custom fabricated bolts, plates, anchors, hanger, dowels, and other miscellaneous steel and iron shapes required for framing, supporting, and anchoring other construction. Galvanized unless otherwise indicated on Drawings.
- F. Steel Posts Bearing on Slab, not included in Section 05120: Provide steel columns, base plates, and attachment hardware bearing on floor slab where shown on Architectural Drawings or specifically noted on Structural Drawings.
 - 1. Interior: Prime paint finish.
 - 2. Exterior: Galvanized.
- G. Miscellaneous Steel Trim: Profiles and sizes as indicated on Drawings; continuous welded joints and smooth exposed edges. Use concealed field splices where possible. Provide cutouts, fittings, and anchorages; coordinate assembly and installation into work of other Sections.
 - 1. Interior: Prime paint finish.
 - 2. Exterior: Galvanized.
- H. Exterior Steel Pipe Bollards (Footing Mounted): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 40.
 - 1. Size: Height and diameter as shown on the drawings.
 - 2. Fill bollard with concrete or provide cap / plug at unfilled bollards as indicated on Drawings.
 - 3. Finish:
 - a. Painted Bollards: Field prime and finish coated in accordance with Section 09900.
 - b. Plastic Sleeve Covered Bollards: Galvanized.

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4. Plastic Sleeves: Install polyethylene thermoplastic pipe sleeves on bollards as specified in Section 06065 and at locations shown on the drawings.
 5. Installation: Install in concrete footing as shown on the drawings.
 6. Plastic Sleeves: Install polyethylene thermoplastic pipe sleeves on bollards as specified in Section 06065.
- I. Interior Steel Pipe Bollards (Core Drilled): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 40.
1. Size: Height and nominal diameter as shown on Drawings.
 2. Fill bollard as indicated on Drawings.
 3. Finish: Hot dip galvanized.
 4. Interior Bollards - Floor Mounted/Bolted:
 - a. Location: Where shown on Drawings.
 - b. Install as indicated on Drawings.
- J. Handrail Brackets: Cast iron with not less than 3-inch projection from wall surface to centerline of handrail. Finish as indicated below.
1. Interior: Prime paint finish.
 2. Exterior: Galvanized.
- K. Door Jambs: Fabricate metal door jambs, as indicated on Drawings, for use at traffic doors and overhead doors. Provide mitered and welded corners, ground smooth. Countersink fasteners, minimum six per jamb.
- L. Protector Angle: Provide continuous steel angles and fasteners, at locations indicated on Drawings. Fabricate angles for attachment to slab-on-grade with 1/2 inch, minimum 4-inch length expansion bolts at maximum 36 inch o.c.
- M. Dock Leveler Pit Angles and Channels: Provide perimeter steel angles with welded studs for dock leveler pits as shown on the drawings. Coordinate fabrication with respective section of work.
1. Galvanize after fabrications.
- N. Elevator Sump Pump Pit Grate:
1. Fiberglass 1 inch deep grate, 1 ½ inch x 1 ½ inch grid pattern. Size as required for pit opening.
 2. Manufacturer: [Delta Composites, LLC](#), Houston TX. Contact Amanda Alexander (281) 449-4900.
 3. Finish: Surface: Smooth. Color: Gray.
- O. Smoke Curtain: Provide continuous steel angles as indicated and required for the erection of overhead supported curtains. Coordinate work with Section 05300. Weld steel angles to roof support. Secure curtain in place with self-tapping metal screws, plumb and level with adjacent construction.
- P. Steel Supports for Overhead Doors, Closures, and Grilles: Channels, tubes, and angles as indicated on Drawings for overhead coiling doors, rolling closures, and overhead coiling grilles. Coordinate fabrication with respective section of work.
- Q. Steel Ladder (Interior):
1. Comply with ANSI A14.3 unless otherwise indicated.
 2. Side Rails: Steel bars size as shown.
 3. Rungs: Solid steel rods size and spacing as shown.
 4. Fit rungs in centerline of siderails. Plug-weld and grind smooth on outer rail faces.
 5. Provide nonslip surfaces on top of each rung by one of the following methods:
 - a. Coating rung with aluminum-oxide granules set in epoxy-resin adhesive.
 - b. Coating rung with abrasive material metallically bonded to rung.
 - c. Use of manufactured rung filled with aluminum-oxide grout.
 6. Finish: Prime paint finish.
 7. Attach ladder to structure with steel mounting brackets.
- R. Water Heater Support Framing: Fabricate support frames and floor-to-roof steel tube bracing as indicated on Drawings for overhead water heater platforms. Provide welded connections, ground smooth.

S. Jib Crane Hoist Arm and Railing:

1. Fabrication jib crane hoist and railings as shown on the drawings.
2. Seal threaded rod penetrations of wall using sealant. Provide a watertight condition. Set support bracket plate in full bed of sealant and seal edge of plate to prevent infiltration of moisture behind plate.

END OF SECTION

SECTION 05510 (05 5100) – METAL STAIRS WITH HANDRAILS – Revise Entire Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Service-type stairs with concrete pan treads.
 2. Industrial-type stairs with steel grating treads.
 3. Steel tube handrails and railings attached to metal stairs.
 4. Steel tube handrails attached to walls adjacent to metal stairs.
 5. Railing gates at the level of exit discharge.
- B. Stairs and stair components may be manufactured and pre-assembled (drop-in) or shop-fabricated or assembled in the field at Contractor's option.
- C. Related Requirements:
1. Section 03310 - Cast-In-Place Structural Concrete. Field-poured treads and landings.
 2. Section 05120 - Structural Steel: Attachments to building framing.
 3. Section 05500 - Metal Fabrications: Building support structure and miscellaneous framing fabrications.
 4. Section 05520 - Metal Pipe and Tube Railings: Stair railings.
 5. Section 09900 - Paints and Coatings. Field-applied finishes.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
1. ANSI A 117.1 - Standard for Accessible and Usable Buildings and Facilities.
- C. ASTM International (ASTM):
1. ASTM A 36 - Carbon Structural Steel.
 2. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A 366 - Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold-Rolled.
 4. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 5. ASTM A 513 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
 6. ASTM A 570 - Steel, Sheet and Strip, Carbon, Hot-Rolled.
 7. ASTM A 569 - Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled.
- D. American Welding Society (AWA):
1. AWS D1.1 - Structural Welding Code - Steel.
 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- E. Americans with Disabilities Act (ADAAG).
- F. Steel Structures Painting Council (SSPC):
1. SSPC-SP3 - Power Tool Cleaning.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 01330.

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- B. Shop Drawings: Stair plans, elevations, details, methods of installation and anchoring.
 1. Show members, sizes and thickness, anchorage locations and accessory items.
 2. Furnish setting diagrams for anchorage installation as required.
 3. Provide calculations stamped by a structural engineer registered in the jurisdiction in which the project is located.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for metal stairs specified in this Section to be installed by firm with minimum of 5 years consecutive metal stair erection experience.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.
- C. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Design and Fabrication Standards:
 1. Fabricate stairs in accordance with the recommendations of "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP-510, for class of stair designated, unless more stringent requirements are indicated.
 - a. Preambled Stairs: Service class.
 - b. Industrial-Type Stairs: Industrial class.
 2. Fabricate railings in accordance with the recommendations of ANSI/NAAMM AMP-521. Finish joints in railings accordance with the following National and Ornamental & Miscellaneous Metal Association (NOMMA) standards:
 - a. Service Stairs, Guard Rails in Non-Public Spaces: Type 3
 - b. Industrial Stairs and Non-public Use Stairs: Type 4
 3. Provide same level of quality for railings guarding floor openings as railings connected to stairs serving opening.
 4. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - a. Service class, unless otherwise indicated.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Packing and Shipping: Deliver stair and rail components in manufacturer's pre-bundled protective wrapping, clearly labeled for stair type and location in building.
- C. Storage and Protection: Store stair and rail components above ground, protected from exposure to the elements and from physical damage caused by other construction activities.

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND REGULATORY REQUIREMENTS

- A. Structural Performance of Stairs: Stairs shall withstand the following structural loads without exceeding the allowable design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component:
 - 1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lb/sf and concentrated load of 300 lbf applied on an area of 4 square inches. Concentrated and uniform loads need not be assumed to act concurrently.
 - 2. Stair Framing: Capable of withstanding stresses resulting from loads specified in addition to stresses resulting from railing system loads.
 - 3. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.
 - 4. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Structural Performance of Handrails and Railings: Handrails and railings shall withstand the following structural loads without exceeding the allowable design working stress of materials, including handrails, railings, anchors and connections.
 - 1. Top Rail of Guardrail: Capable of withstanding a concentrated load of 200 lbf applied in any direction and a uniform load of 50 lbf/ft applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.
- C. Regulatory Requirements: Comply with applicable provisions of local building code, ADAAG and ANSI A117.1 as applicable for stairs and handrails.

2.2 MATERIALS

- A. Steel Shapes and Plates: ASTM A 36.
- B. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- C. Steel Tubing:
 - 1. Structural Use: ASTM A 500, Grade C.
 - 2. Non-Structural Use: ASTM A 513, hot rolled or coiled rolled (mill option).
- D. Steel Sheet:
 - 1. Structural Use: ASTM A 570 (hot rolled) or A 366 (cold rolled).
 - 2. Non-Structural Use: ASTM A 569 (hot rolled) or A 366 (cold rolled).
- E. Fasteners and Accessories: Provide anchor bolts, clip angles, hanger rods and other hardware, accessories and incidental materials required for complete installation of stairs and rails.
- F. Welding Materials: Conform to AWS code and AWS filler metal specifications for material being welded.

- G. Primer: Acrylic Latex rust-inhibitive primer containing less than 1.0 lb/gal volatile organic compounds (VOC), certified to be compatible with finish coats specified in Section 09900.
- H. Concrete Materials and Reinforcement: Comply with the applicable requirements of Division 3.

2.3 FABRICATION

- A. Use same material and finish as parts being joined, except use stainless steel between dissimilar metals and non-corrosive fasteners at exterior connections or joints.
- B. Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.
- C. Construct stairs and rails with all components necessary for support and anchorage, and to provide a complete installation.
- D. Shop welding and joining shall conform to AWS D1.1 and AWS D1.3 requirements.

2.4 STANDARD STAIR AND RAIL SYSTEM

- A. Stairs and Landing: Manufacturer's standard prefabricated, pre-assembled stair and landing system, consisting of hot rolled steel sheet treads, risers, and landings. Stringers shall be steel channel with side mounted prefabricated railings.
 - 1. Stringers: Minimum thickness or gauge as determined by structural design calculations, structural grade steel channel.
 - 2. Risers: Closed riser, minimum 14-gauge hot-rolled mild steel sheet, sloped maximum 1-1/2 inches and conforming to ADAAG nosing requirements.
 - 3. Treads: Manufactures standard concrete pan system (Field Poured). Tread pans shall be minimum of 14 gauge, or as determined by design calculations. Pan depth 1-1/2 inches. Welds shall be exposed and visible after installation for subsequent inspections.
 - 4. Refer to Division 3 for concrete and field finish of treads.
 - 5. Mid Landings: Minimum of 11 gauge hot-rolled mild steel sheets, formed for a minimum 3 inches concrete fill, with 12 gauge channel supports and bracing welded to perimeter frame at 12 inches o.c.
 - 6. Fasteners and Supports: Sized by manufacturer to meet the structural design criteria.
- B. Railing: Manufacturer's standard welded steel tube handrail complying with the following requirements:
 - 1. Rails: 1-1/2 inches diameter by minimum 13 gauge round steel tube, continuous multi strand type, equally spaced not more than 3-15/16 inches clear between strands, and with a minimum extension per code at top and bottom risers. Wrap rail continuously past space between fights to form guardrail as required by building code. Terminate rail ends with radiused returns, newel posts, or safety terminations approved by local code. Provide brackets as required to attain clear distance between rail and wall as shown on the drawings.
 - 2. Rail Posts: 1-1/2 inches square by 11-gauge tubing. Rail posts to fasten to side of plate stringers per manufactures shop drawings. Manufacture to pre-weld erection aid to rail post for proper height to aid stair erector. Erection aid (setting block) to be removed and weld ground smooth after installation.
 - 3. Fabrication:
 - a. Use preformed or prefabricated bends.
 - b. Butt weld tee and cross intersections in tubing; cope and weld intersections in pipe. Miter elbows.
 - c. Mechanically fasten internal sleeves and fittings.
 - d. Provide minimum 3/16-inch welded steel plate closures or hemispherical closure fittings on all exposed rail ends.

2.5 SHOP CLEANING AND FINISHING

- A. Rails and Stair Components: Completely remove oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter from surface of steel in accordance with SSPC-SP3.

- B. Shop Primer: Immediately after shop fabrication and cleaning, spray apply one coat of anti corrosive primer to a minimum dry film thickness as recommended by primer manufacture, but not less than 2.0 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates and adjacent construction have been properly constructed. Verify structural framing, enclosures, weld plates, blocking, and size and location of pockets.
- B. If unsatisfactory conditions are encountered, notify Architect in writing. Do not proceed until unsatisfactory conditions have been corrected.
- C. Notify Manufacturer of any detail, design or tolerance deviations as noted or drawn on stair shop drawing.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.3 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, non-shrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post installed anchors and bolts.

3.5 ADJUSTING AND CLEANING

- A. Touch-up field welds and abraded areas by application of same coating used for shop primer.
- B. After stairs are completely installed, clean surface of exposed rail and stairs with wet cloth or mop. Leave stair system ready for finish painting.

3.6 CONCRETE FILL TREATMENTS

- A. Concrete Placement: Place concrete in accordance with Section 03310. Provide steel trowel finish.

END OF SECTION

SECTION 05513 – GUARDRAIL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Prefinished and Prefabricated metal guardrail protection systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Prefinished and Prefabricated metal guardrail systems.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Specifications for quality are based on Steel Guard Protective Railing system as manufactured by Steel King. Another listed manufacturer's product of a similar and equivalent nature will be acceptable when, in the Architect's sole judgment, differences do not detract from the design concept or intended performance.

2.2 FERROUS METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions required; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Anchors, General: Anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- I. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors .
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 Class Fe/Zn 5, unless otherwise indicated.

2.4 MATERIAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Post construction:
 - 1. Wall thickness: 1/4"
 - 2. Size: 4" x 4"

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3. Height: 42-5/8"
4. Post Cap: Stainless Steel
5. Base Plate: Centered, unless offset is indicated on drawings.
6. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Rail construction:

1. Wall thickness: 11 ga.
2. Shape: Corrugated
3. Post Connection: Bolted
 - a. Utilize manufacturer standard removable rail sections with saddles bolted to the posts where indicated on drawings.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
- D. Powder-Coated Finish: Prepare, treat, and coat metal to comply with resin manufacturer's written instructions and as follows:
 1. Prepare metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
 2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils.
 4. Prefabricate systems to greatest extent possible prior to finishing to reduce quantity of mechanical anchors used on-site.
 5. Color: Safety Yellow

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Install per manufacturers written instructions.
- C. Coordinate final locations with owner prior to installation. Provide complete "dry" (not anchored in place) mock-up of each unique condition for owner approval in final location prior to final anchoring.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install per manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

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END OF SECTION

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SECTION 05520 (05 5200) – METAL PIPE AND TUBE RAILINGS – Add Section

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

B. Related Requirements:

1. Section 05510 - Metal Stairs with Handrails: steel tube railings associated with metal pan stairs.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Perforated metal infill panels.
2. Woven-wire mesh infill panels.
3. Fasteners.
4. Post-installed anchors.
5. Handrail brackets.
6. Shop primer.
7. Intermediate coats and topcoats.
8. Bituminous paint.
9. Nonshrink, nonmetallic grout.
10. Anchoring cement.
11. Metal finishes.
12. Paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

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- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- D. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Keep material off the ground using blocking or pallets prior to installation.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction unless noted otherwise on the drawings.
- B. Structural Performance: Railings, including attachment to building construction, to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes for exterior railings.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Steel Handrail Wall Brackets: Center of rail 3 inches from face of wall with predrilled holes for exposed bolt anchorage.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide TrueNorth Steel; Model 00012 or comparable product by one of the following:
 - a. [Blum, Julius & Co., Inc.](#)
 - b. [The Wagner Companies., R&B Wagner, Inc.](#)
- C. Flanges and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL RAILINGS AND GUARDS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A500 (cold formed) or ASTM A513, Type 5.
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.
- E. Perforated-Metal Infill Panels:
 - 1. Cold-Rolled Steel Sheet: ASTM A1008, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel, Type B, 0.060 inch thick, with 1/4-inch holes in staggered rows.
 - 2. Galvanized-Steel Sheet, ASTM A653, G90 coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- F. Woven-Wire Mesh Infill Panels: Intermediate-crimp, **square** pattern, 2-inch woven-wire mesh, made from 0.134-inch diameter steel wire complying with ASTM A510.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with **ASTM F194**, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
 - 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
 - 1. Provide fastener's as shown when noted on the drawings.

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- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
 - 1. Refer to section 05090 for additional criteria.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- G. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- H. Nonshrink, Nonmetallic Grout: Provide per section 03310.
- I. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded or bolted connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
- I. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- K. Form changes in direction as follows:
 - 1. By bending. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members using manufacturer's standard materials and procedures.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- Q. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

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1. Provide socket covers designed and fabricated to resist being dislodged.
 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- R. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from steel.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
 2. Orient perforated metal with pattern as indicated on Drawings.
- S. Woven-Wire Mesh Infill Panels: *Fabricate* infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.
1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
 2. Orient wire mesh with as indicated on Drawings.
- T. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL FINISHES

- A. Galvanized Railings:
1. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 2. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
 3. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 4. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by manufacturer's standard materials and procedures.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
1. Exterior Railings: SSPC-SP 6/NACE No. 3.
 2. Other Railings: SSPC-SP 3.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with universal shop primer.
 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish:
1. Color: As indicated by manufacturer's designations and approved by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Install railings in accordance with manufacturer's written instructions and approved Shop Drawings.
- B. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 ft.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Use steel baseplates anchored into concrete for installing posts. Where baseplate and anchorage are not specified on the drawing, manufacturer shall provide the design.
- B. Install removable railing sections, where indicated, in slip-fit steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach handrails to walls with wall brackets, Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use LDT or screw anchors.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.

3.6 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 06065 - PLASTIC MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic Sleeve: Thermoplastic polyethylene pipe sleeves for steel pipe bollards
- B. Related Sections:
 - 1. Section 01600 - Product Requirements: Contractor's Product Selection Checklist.
 - 2. Section 05500 - Metal Fabrications: Steel pipe bollards to receive plastic sleeves.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect Products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with project requirements, provide plastic bollard sleeves by one of the following manufacturers.
 - 1. Ideal Shield, Detroit, MI, Chris Parenti or Ashley Kozlowski, (866) 825-8659 or (313) 842-7290: email: cparenti@idealshield.com or info@idealshield.com.
 - 2. Post Guard, Farmington Hills, MI, Betty Steinke, (866) 737-8900; email: betty@postguard.com.
 - 3. Ultratech International, Inc., Jacksonville, FL, (800) 764-9563.

2.2 SUPPLIERS

- A. Specified products may be procured from the following suppliers.
 - 1. Bollard Sleeves:
 - a. Grainger Industrial Supply, Lake Forest, IL; Customer Service (800) 472-4643.
 - b. Uline, Pleasant Prairie, WI; Customer Service (800) 295-5510.
 - c. Fastenal, Winona, MN; Customer Service (877) 507-7555.
 - d. The Crowd Control Store, Fort Lauderdale, FL ((866) 304-2916.

2.3 PRODUCTS

- A. Polyethylene thermoplastic (LDPE or HDPE) molded plastic bollard sleeve.
 - 1. Size: 1/8-inch thickness, 52" high (field verify height) to fit 4-inch or 6-inch diameter pipe bollards as shown.
 - 2. Color: Provide color shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Plastic Sleeves:
 - 1. Install (2) beads of clear 100% silicone sealant by starting beads at opposite sides of top of bollard and spiraling downward, making one complete revolution of bollard with each bead.
 - 2. Slide sleeve over bollard seating sleeve in sealant.
 - 3. Allow sealant to cure and verify sleeve holds fast to bollard.
 - 4. Repeat installation if sleeve can be removed easily from bollard.
 - 5. Do not install sleeves with manufacturer's double sided foam tape.

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END OF SECTION

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SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preservative and fire resistive treatment.
2. Concealed blocking behind wall mounted items.
3. Non-structural panel products including the following:
 - a. Backing for electrical and telephone equipment.
 - b. Panels concealed within gypsum board and metal stud partitions.
 - c. Panels used as finish material; walls, ceilings, wainscots, and bases.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Lumber Standards Committee (ALSC):
 1. Softwood Lumber Standards.
- C. American Plywood Association (APA):
 1. Grades and Standards.
- D. ASTM International (ASTM):
 1. ASTM A 123/A - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 3. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 4. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 5. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 6. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 7. ASTM E 1333 - Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
- E. American Society of Mechanical Engineers (ASME):
 1. ASME B18.6.1 - Wood Screws (Inch Series)
- F. American Wood Protection Association (AWPA):
 1. AWPA M4 - Care of Preservative Treated Wood Products.
 2. AWPA U1 - User Specification for Treated Wood.
- G. Department of Commerce (National Institute of Standards and Technology) - Product Standard (DOC):
 1. DOC PS 1 - Construction and Industrial Plywood.
 2. DOC PS 2 - Performance Standard for Wood Based Structural Use Panels.
 3. DOC PS 20 - American Softwood Lumber Standard.
- H. Southern Pine Inspection Bureau (SPIB):
 1. Grading Rules.
- I. Western Wood Products Association (WWPA):
 1. Western Lumber Grading Rules.

- J. Underwriters' Laboratories (UL):
 - 1. UL FR-S Classification - Fire Retardant Treated Wood with Flame Spread Ratings of 25 or less in accordance with ASTM E84.
 - 2. UL 723 - Test for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

- A. Lumber Grading Agency: Lumber to be grade stamped by an agency certified by the Board of Review of the American Lumber Standards Committee (ALSC).
- B. Plywood Grading Agency: Certified by APA.
- C. Regulatory Requirements: Conform to applicable codes for fire retardant treatment of wood surfaces for flame/smoke ratings.
- D. Composite Wood Products: Hardwood plywood, particleboard, and medium density fiberboard composite wood products specified herein for exterior or interior applications shall meet the requirements for formaldehyde as specified by the California Air Resources Board, Air Toxics Control Measure for Composite Wood as tested in accordance with ASTM E 1333, and Chap 5 of the CALGreen requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Provide proper facilities for handling and storage of materials to prevent damage to edges, ends and surfaces.
- C. Keep materials dry. Stack materials off ground a minimum of 12 inches or if on concrete slab-on-grade a minimum of 1-1/2 inches, fully protected from weather. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

- A. Lumber: DOC PS 20; S4S. Maximum of 19 percent moisture content, surfaced dry, No. 2 any species graded under WWPA grading rules or No. 3 Grade Southern Pine graded under SPIB grading rules.
- B. Plywood Backing Panels: DOC PS 1, Exposure 1, Grade C Plugged veneer, fire retardant treated, thickness indicated but not less than 1/2 inch nominal thickness.
- C. Nonstructural Panel: DOC PS 1 or PS 2, fire retardant treated plywood.
 - 1. Type 1 (Interior): Grade C-D Plugged veneer, Exposure I, locations and thickness indicated on the Drawings.
 - 2. Type 2 (Exterior): Grade B-B veneer, Exterior, locations and thickness as indicated on the Drawings.
- D. High Density Wood Fiber Panel Products: Provide one of the following panels with span rating as required to suit support spacing indicated on drawings. Thickness as indicated on drawings.
 - 1. EnergyGuard High Fiberboard, by GAF, (800) 766-3411.
 - 2. Huebert Fiberboard Roof Insulation, by Huebert Brothers Products, LLC; Booneville, MO (816) 882-2704.

2.2 FASTENERS

- A. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity: Comply with the treated lumber manufacturer's recommendations for fasteners and metal components in contact with treated lumber.
 - 1. Fasteners: ASTM A 153, class D for hot dip galvanized fasteners or type 304 or type 316 stainless steel.
 - 2. Other components: ASTM A 653, G-185, with minimum of 1.85 ounces of zinc coating per square foot coverage or type 304 or type 316 stainless steel.
- B. At no time shall any galvanized metal, stainless steel, or other dissimilar metals be in contact with one another.
- C. Nails, Brads and Staples:
 - 1. ASTM F 1667 Galvanized for exterior locations and high humidity areas, and for treated wood
 - 2. ASTM A123 plain finish for other interior locations.
 - 3. Size and type to suit application, unless otherwise noted.
- D. Bolts, Nuts, Washers, and Lag Screws: ASTM A307, Medium carbon steel; size and type to suit application; galvanized for exterior locations, high humidity areas, and treated wood; plain finish for other interior locations, of size and type to suit application, unless otherwise noted.
- E. Wood Screws: ASME B18.6.1
- F. Toggle Bolt Fasteners: For anchorage of non-structural items to hollow masonry.
- G. Expansion Shield Fasteners: For anchorage of non-structural items to solid masonry and concrete.
- H. Powder or Pneumatically Actuated Fasteners: For anchorage of non-structural items to steel.
- I. Fasteners for Wood and Plywood to Light Gage Metal Framing and Metal Deck (up to 10 gage, 0.1345 inch): Self-drilling flat head wood-to-metal screws.
 - 1. Manufacturers:
 - a. Hilti, Tulsa, OK (800) 879-6000.
 - b. ITW Buildex, Itasca, IL (800) 323-0720.
 - 2. Wood and Plywood Up to 3/4 Inch Thick:
 - a. Hilti: S-WD 8-18 x 1-15/16 PFH #3 Black Phosphated.
 - b. ITW: Traxx 10-16 #3 point.
 - c. Pre-drill wood if wood thickness is greater than 1/2 inch or use heavier fastener specified below.
 - 3. Wood less than or equal to 1-1/8 inch thickness to 18 Gage (0.0478 inch) and 20 Gage (0.0359 inch) Metal:
 - a. Hilti: S-WD 10-24 x 1-1/2 PWH #3 wafer head screw.
 - b. ITW: Traxx 10-16 #3 point.
 - c. Pre-drill wood if wood thickness is greater than 1/2 inch.
 - 4. Wood less than or equal to 1-3/4 inch thickness to 16 Gage (0.598 inch) and Heavier Metal (less than or equal to 0.232 inches):
 - a. Hilti: S-WW 12-24 x 2-1/2 PFH #4 Wings.
 - b. ITW: Traxx 12-24 #4 Point with Wings.
 - 5. Wood less than or equal to 2-inch thickness to 16 Gage (0.598 inch) and heavier metal (less than or equal to 1/4 inch):
 - a. Hilti: S-WW 1/4-20 x 2-3/4 PFH #4 Wings.
- J. Fasteners for Non-Structural Wood Members to Masonry: Masonry screw anchor with Phillips or Torx flat head, size and length as shown on the drawings.
 - 1. Hilti: Kwik-Con II fastener.
 - 2. ITW: Tapcon masonry anchor.

- K. Alternate Manufacturers: Subject to compliance with project requirements, fasteners by alternate manufacturers of equal types to those specified may be provided, except where substitutions are specifically prohibited.

2.3 WOOD TREATMENT

A. Preservative Pressure Treated Lumber Treatment:

1. Products and Manufacturers: Provide any of the following:
 - a. Wolman CCA, by Arch Wood Protection, Smyrna, GA, (770) 801-6600.
 - b. CCA Pressure Treatment by Hoover Treated Wood Products Inc., Thomson, GA, (800) .832-9663.
 - c. SupaTimber, by Viance, Charlotte, NC, (800) 421-8661.
2. Treat lumber in accordance with AWWA U1; Use Category UC2 for interior construction not in contact with the ground; Use Category UC3b for exterior construction not in contact with the ground; and Use Category UC4a for items in contact with the ground.
3. Preservative Chemicals shall be acceptable to Authorities Having Jurisdiction and contain no arsenic or chromium where prohibited.
4. Kiln dry lumber after treatment to 15-19 percent moisture content. Do not use warped material or materials that do not comply with requirements for untreated material. Material to be painted or stained shall have knots and pitch streaks sealed as with untreated wood.
5. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review and acceptable to Authorities Having Jurisdiction.

B. Field-Applied Lumber Preservative:

1. Provide the following:
 - a. Inorganic boron.
 - b. Copper naphthenate.

C. Fire Retardant Treatment:

1. Products and Manufacturers: Provide any of the following:
 - a. Dricon FRT (exterior and interior), by Arch Wood Protection, Smyrna, GA, (770) 801-6600.
 - b. Exterior X (exterior) and Pyro-Guard (interior) by Hoover Treated Wood Products, Inc.; Thomson, GA; (800)-832-9663.
 - c. D-Blaze (interior) by Viance, Charlotte, NC; (800) 421-8661.
2. Identify fire retardant treated wood with appropriate classification marking of testing and inspecting agency acceptable to Authorities Having Jurisdiction.
3. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
4. Kiln dry lumber after treatment, to an average moisture content of 19 percent or less.
5. Kiln dry plywood after treatment, to an average moisture content of 15 percent or less.
6. Chemicals used to treat material shall be free of halogens, sulfates, ammonium phosphate and formaldehyde.
7. Treatment material shall provide protection against termites and fungal decay and shall be registered for use as a wood preservative by the U. S. Environmental Protection Agency.

D. Wood Requiring Treatment:

1. Lumber, Preservative Treated:
 - a. Nailers, blocking, stripping, and similar items in conjunction with roofing, flashing, and other construction.
 - b. Sills, blocking, furring, stripping, and similar items in contact with masonry or concrete.
2. Lumber, Fire Retardant Treated:
 - a. Wood in concealed spaces.
 - b. Wood exposed within the roof/ceiling assembly.
3. Interior Plywood, Fire Retardant Treated:
 - a. Plywood used as finish material, walls, wainscots, and bases in fire-rated corridors.
 - b. Plywood backing for electrical and telephone equipment.
 - c. Plywood performing a structural function, such as a component of roof, floors or shear walls.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive rough carpentry work and verify following:
 - 1. That installation of building components to receive rough carpentry work is complete.
 - 2. That surfaces are satisfactory to receive work.
 - 3. That spacing, direction and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailing strips.

3.2 SITE TREATMENT OF WOOD MATERIALS

- A. Wood Treatment at Site: Comply with AWWA M4 for applying field treatment to cut surfaces of preservative treated lumber.
 - 1. Use inorganic boron for items continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.

3.3 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
 - 1. Construct members of continuous pieces of longest possible lengths.
 - 2. Do not splice structural members between supports, unless otherwise indicated.
- B. Provide blocking and framing indicated and necessary to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- C. Secure members in place with specified fastener. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Do not countersink nail heads unless otherwise indicated.
- D. Wood Ground, Sleeper, Blocking, and Nailer: Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - 1. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
 - 2. Recess heads of fasteners below surface of wood members.
- E. Wood Furring: Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- F. Install firestopping complying with Section 07840 in concealed spaces with wood blocking, horizontally and vertically in accordance with drawings, minimum 2 inches thick where space is not blocked by framing members.
- G. Fasteners: Install fasteners with manufacturer's recommended power tool for each type of fastener.

3.4 PROTECTION

- A. Protect rough carpentry from weather throughout construction period.

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END OF SECTION

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SECTION 061500 (06 1500) – WOOD DECK PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mezzanine wood deck floor panels.
 - 2. Wood deck panel fasteners.
- B. Related Requirements:
 - 1. Section 05120 - Structural Steel:
 - a. Structural steel for framed openings.
 - b. Support plates and angles.
 - 2. Section 05300 – Metal Deck: Support decking for mezzanine flooring panels.
 - 3. Section 06100 – Rough Carpentry: Edge of panel support shims.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Indicate component materials and dimensions and include construction and installation details.
 - 2. Include data for fasteners.
 - 3. Include orientation of panels during installation.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Metal Deck Supplier will deliver products to site to be received by Contractor as specified in Section 01600.
- B. Stack with spacers beneath and between each bundle to provide air circulation. Store inside building only after building is fully enclosed and protected from the elements. Provide for air circulation around stacks and under coverings.
- C. Panels to be stored flat and level.
- D. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- E. Keep materials dry. Separate sheets and store deck on dry wood sleepers; slope for positive drainage. Protect with a waterproof covering and ventilate to avoid condensation.
- F. Prevent damage to edges, ends, and surfaces.

1.5 WARRANTY

- A. Manufacturer's Durability Warranty: Manufacturer's standard form providing warranty against structural integrity and finish coating. Finish coating defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS:

- A. ResinDek; Cornerstone Specialty Wood Products, LLC.
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

2.2 MATERIALS

- A. Basis of Design: Engineered wood deck panels meeting the following criteria:
 - 1. Panel Type: ResinDek MD.
 - 2. Panel Finish: Gray Diamond Seal 2 with ESD coating.
 - 3. Panel Edges: Tongue and groove.
 - 4. Panel Thickness: $\frac{3}{4}$ inch.
 - 5. Panel Attachment: Fully countersunk color matched top side screws. Spacing per manufacturer's standard recommendation.
 - 6. Load limit: As indicated on drawings.
- B. Substitutions: Subject to compliance with requirements, another manufacturer's product of a similar and equivalent nature is to be approved in writing by Architect of Record and Structural Engineer of Record during Bidding. Equivalent is defined, in the Architect's and Engineer's sole judgment, as containing differences that do not materially or aesthetically detract from the design concept or intended performance.

2.3 MISCELLANEOUS ACCESSORIES

- A. General: Provide accessories as required by manufacturer to provide for a complete installation.
 - 1. Minimum 20 ga. steel shims as required to bridge deck flutes at panel joints.
 - 2. Color matched screws provided by manufacturer of wood floor covering panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and adjacent areas where products and materials will be installed and verify that conditions conform to product manufacturer's requirements. Verify that wood deck supporting framing and metal deck components are ready to receive Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install panels in strict accordance with manufacturers written instructions.
- B. Orient panels with long edges of panels running perpendicular to the steel deck ribs wherever possible.
- C. Provide a 3/8" gap/space on outer edges of panels and a 1/8" gap/space between panels.
- D. Insert metal spacers (2 along one long edge, 1 along a short edge) between all adjacent panels during panel installation. Remove after panels are firmly affixed.
- E. Attach panels to corrugated metal platform deck using manufacturer's recommended minimum number of fasteners per 4' x 8' sheet. Locate fasteners a minimum of 1" from tongue and groove edges and from square edges.
- F. Stagger panels so that joints break on different deck ribs wherever possible. Long joints to run perpendicular to steel decking below. Short joints to be staggered at least one-third of a panel.
- G. All panel joints should break on ribs. 6" wide x 20-gauge minimum steel shims must be used when panels break on a valley.
- H. Fasteners must be long enough to penetrate both the panel and securely into the deck. Secure each panel with a

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minimum of four fasteners before installing the next panel. Use only screw guns with a nose clutch to countersink screw heads. Drive fasteners so the countersunk head is just below the panel surface.

- I. Use carbide tipped saw blades to trim panels.
- J. Provide perimeter closure plates/strips at all perimeter gaps.
- K. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

3.3 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not preclude Contractor responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.4 PROTECTION

- A. Protect installed panels as recommended by the manufacturer against damage after installation.

END OF SECTION

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4091-500: Stockton (SMF2), CA - 96530402

October 5th, 2022

SECTION 06165 - FIBERBOARD PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tack bulletin boards.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C 209 - Test Methods for Cellulosic Fiber Insulating Board.
 - 2. ASTM C 954 - Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 inches to 0.112 inches in Thickness.
 - 3. ASTM C 1002 - Steel Self-Piercing Tapping Screws for The Application Of Gypsum Panel Products Or Metal Plaster Bases To Wood Studs Or Steel Studs.
 - 4. ASTM D 1037 - Test Methods of Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
 - 5. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

1.5 PROJECT CONDITIONS

- A. Acclimatize panels to existing moisture conditions and for not less than 24 hours before installation. Comply with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fiberboard: Molded, recycled post-consumer paper, cellulose fiber structural panel manufactured and constructed as acoustic board insulation.
 - 1. Thickness: 1/2 inch.
 - 2. Density: Minimum 15 pcf when tested in accordance with ASTM C209.
 - 3. Tensile Strength: Minimum 150 psi parallel and 600 psi perpendicular when tested in accordance with ASTM C209.
 - 4. Water Absorption by Volume: Not to exceed the maximum percent when tested in accordance with ASTM D 1037.
 - 5. Expansion: 50 to 90 percent relative humidity in accordance with ASTM C209.
 - 6. Thermal Resistance: When tested in accordance with ASTM C209 per ASTM C518:
 - a. R-value: 1.2

7. Flame Spread: 76 to 200 tested in accordance with ASTM E84, Class III or C.
8. Subject to compliance with requirements specified herein, provide fiberboard manufactured by one of the following:
 - a. [440 Sound Barrier](#) by Homasote Company, West Trenton, NJ (800) 257-9491.
 - b. [Soundstop](#) by Blue Ridge Fiberboard, (800) 535-4088 or (800) 233-8721.
 - c. Equivalent product by other manufacturers.

B. Trim: Casing as shown on Drawings.

2.2 ACCESSORIES

A. Panel Fasteners:

1. Fastening to sheathing: ASTM C 954 and C 1002, Type S-12 bugle head, corrosion-resistant self-drilling self-tapping steel screws; length as required to penetrate framing members 3/4" minimum.
2. Fastening to concrete masonry unit (CMU): Masonry screw anchor with Phillips or Torx flat head, 3/16 inch in diameter x 1-3/4 inch. Provide one of the following:
 - a. Kwik-Con II fastener by [Hilti](#), Tulsa, OK (800) 879-6000.
 - b. Tapcon masonry anchor by [ITW Buildex](#), Itasca, IL (800) 323-0720.

B. Trim Fasteners: As shown on Drawings.

C. Field Applied Paint Finish for Panel and Trim: Water-based acrylic enamel, semi-gloss, as specified in Section 09900 for wood substrates.

1. Color: Match color of adjacent wall as shown on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrate in accordance with fiberboard panel manufacturer's recommendations.
- B. Beginning of installation is acceptance of substrate.

3.2 INSTALLATION

- A. Install panel where noted on the Drawings in accordance with manufacturer's instructions.
- B. Install only clean, dry, undamaged panels.
- C. When fastening panel to CMU, provide drills equipped with a HEPA-rated filter vacuum dust collection system recommended by the manufacturer to maintain dust emissions below the permissible level.
 1. Drill pilot holes accurately and squarely. Clean holes in accordance with the manufacturer's recommendations using a HEPA-rated filter vacuum.
- D. Install panel trim pieces concurrently with installation of panels. Miter cut panel trim at corners to provide smooth transition. Ensure moldings are straight and correctly aligned.
- E. Prepare and paint installed trim as specified in Section 09900 for wood substrates.
- F. Apply continuous bead of sealant in corner seams.
- G. Sealant shall not be visible in completed system.

END OF SECTION

SECTION 06200 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior standing and running trim.
 - 2. Shelving.
- B. Related Sections:
 - 1. Section 06100 - Rough Carpentry: Panel product used as finish material on walls, ceilings, wainscots, and bases.
 - 2. Section 06400 - Architectural Woodwork: Plastic laminate casework and wainscoting.
 - 3. Section 09900 - Paints and Coatings: Opaque and transparent finishes.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Woodworking Institute (AWI):
 - 1. AWI - Quality Standards.
- C. American Plywood Association (APA):
 - 1. APA - Grades & Specifications.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Material and Equipment: Transport, handle, store, and protect products.

PART 2 - PRODUCTS

2.1 WOOD MATERIALS

- A. Interior Standing and Running Trim : AWI Custom Grade; plain sawn, Grade II lumber.
 - 1. Painted Finish: Closed-grain hardwood, any species
 - 2. Clear Sealed Hardwood: One of the following hardwood species. Use one species throughout
 - a. Ash.
 - b. Birch.
 - c. Oak.
- B. Shelving - Clear Sealer Finish: Fir or birch plywood with veneer core and sanded edges.
 - 1. APA 5-ply A/C, 3/4 inch thickness at Stockroom shelving.
 - 2. APA 5-ply A/B at other locations.
- C. Panel Product for Finish Material on Walls, Ceilings, Wainscots, and Bases: See Section 06100.

2.2 HARDWARE

- A. Fasteners: Size and type to suit application; galvanized for exterior and high humidity locations; plain finish at other locations.

2.3 FABRICATION

- A. Fabricate to AWI Standards.
 - 1. Standing and Running Trim: Custom Grade.
 - 2. Wood Shelving with Clear Sealer: Economy Grade.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install woodwork plumb, level, and straight without distortion; use concealed shims. Scribe and cut woodwork to fit adjoining work. Anchor woodwork items to nailers or blocking or directly to substrate using concealed fasteners.
- B. Standing and Running Trim: Install with minimum joints, using maximum lumber lengths possible. Cope at returns; miter at corner.
- C. Wood Shelving: Assemble units and install as indicated on Drawings.
- D. Site Finishing: Refer to Section 09900.

END OF SECTION

SECTION 06400 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic Laminate Casework provided or modified by Contractor.
2. Architectural slat wall panel for installation by Contractor.

B. Related Sections:

1. Section 01600 - Product Requirements: Contractor's Product Selection Checklist.
2. Section 06100 - Rough Carpentry: Lumber and panel products used for wood and wire mesh doors.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American National Standards (ANSI):

1. ANSI A208.1 - Particleboard
2. ANSI A208.2 - Medium Density Fiberboard For Interior Use

C. Architectural Woodwork Institute (AWI) / Architectural Woodwork Manufacturers Association of Canada (AWMAC) / Woodwork Institute (WI) - Joint Publication:

1. AWI/AWMAC/WI - Architectural Woodwork Standards.

D. Engineered Wood Association (APA): APA - Grades & Specifications.

E. National Electrical Manufacturer's Association (NEMA)

1. NEMA LD3 - High-Pressure Decorative Laminates

1.3 DELIVERY, STORAGE AND HANDLING

A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.

B. Inspect materials delivered and reject those not qualifying with requirements, those damaged in transit, or those that appear otherwise unsatisfactory.

C. Schedule delivery of items to installation areas that are in proper condition to receive them. Place items neatly and systematically to avoid damage, store in clean, dry, enclosed, and secure storage area.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. High Pressure Laminate (HPL): Provide products by one of the following as specified in the Color/Pattern Schedule below:

1. Formica Corporation; Indianapolis, IN; Contact: Megan Shaughnessy; (513) 786-3039.
2. Nevamar Decorative Surfaces (a subsidiary of Panolam Surface Systems) Shelton, CT. Contact: Tricia Rongitsch, (612) 618-4754, www.panolam.com/distributors
3. Panolam Surface Systems, Shelton, CT. Contact: Tricia Rongitsch, (612) 618-4754, or (877) 726-6526, www.panolam.com/distributors
4. Pionite Decorative Surfaces (a subsidiary of Panolam Surface Systems) Shelton, CT. Contact: Tricia Rongitsch, (612) 618-4754.

5. Wilsonart; Temple, TX; Contact: Marty Click (214) 502-4084.
 6. Omnova Solutions, (866) 332-5226, laminates@omnova.com
- B. Thermofused Melamine Panel (TFM): Provide products by one of the following manufacturers:
1. Panolam Surface Systems, Shelton, CT. Contact: Tricia Rongitsch, (612) 618-4754, or (877) 726-6526.
 2. [Funder America, Inc.](#), Mocksville, NC (336) 751-3501.
 3. [Roseburg Forest Products](#), Roseburg, OR (800) 245-1115.
- C. Panel Products (MDF and Particleboard): Provide products by one of the following manufacturers:
1. Arauco North America, Atlanta, GA, (800) 261-4890.
 2. Georgia Pacific Building Products, Atlanta, GA, (800) 284-5347.
 3. Homasote, West Trenton, NJ, (800) 257-9491.
 4. Roseburg Forest Products, Springfield, OR, (800) 245-1115.
- D. Accessories:
1. Metal trim:
 - a. Macklanburg-Duncan, Oklahoma City, OK (800) 654-8454.
 - b. Outwater Plastics Industries, Inc.
 - 1) East Coast: Bogota, NJ (800) 631-8375.
 - 2) West Coast: Phoenix, AZ (800) 248-2067.
 - c. Stylmark, Fridley, MN (800) 328-2495.
 2. Adhesives:
 - a. Wilsonart; Temple, TX; Contact: Marty Click (214) 502-4084.
 - b. ITW Polymers Sealants North America, Irving, TX, (800) 878-7876.
 - c. Franklin International, Columbus, OH, (800) 877-4583.

2.2 SUPPLIERS

- A. Specified products may be procured from the following suppliers.
1. McKillican American, Edmonton, AB Canada, (888) 252-7993. Multiple locations serving Western US, Hawaii and Texas.
 2. Sherwood Lumber Corp., Melville, NY, (800) 645-6226. Multiple locations across continental US.
 3. Wurth Baer Supply Company, Vernon Hills, IL, (800) 289-2237. Multiple locations serving Northeast and Midwest US.

2.3 LAMINATE MATERIALS

- A. High pressure laminate (HPL); NEMA LD3; color, pattern, and finish as indicated in this Section.
1. Exposed Horizontal Surfaces: GP-50.
 2. Exposed Vertical Surfaces: GP-50.
 3. Postformed Surfaces: PF-42.
 4. Thickness: Nominal 0.050 inch thick.
- B. Thermofused Melamine Panel (TFM): Particleboard or medium density fiberboard (MDF) finished with thermally fused, melamine impregnated decorative paper.

2.4 PANEL PRODUCT

- A. Medium Density Fiberboard (MDF), ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde resin.
- B. Particleboard, density 45 lb., ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde resin.

2.5 ACCESSORIES

- A. Adhesives: Low VOC adhesive, as recommended by laminate manufacturer and suitable for shop or field application.
 - 1. Toxicity / IEQ:
 - a. Comply with applicable regulations regarding toxic and hazardous materials.
 - b. Comply with Green Seal Standard GS-36 for commercial aerosol adhesives.
 - c. Comply with California's South Coast Air Quality Management District (SCAQMD) Rule No. 1168 in areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur. In areas where freeze/thaw conditions exist or direct exposure to moisture can occur, then comply with California's Bay Area AQMD Regulation 8, Rule 51 for containers larger than 16 oz. and with California Air Resource Board (CARB) for containers 16 oz or less.
 - 2. Acceptable Products: Provide the following or equivalent as recommended by laminate manufacturer.
 - a. Wilsonart 3000 Adhesive Series.
 - b. [Sta'-Put SP80](#).
 - c. Titebond
- B. Fasteners: Unless otherwise recommended by the manufacturer, use size and type to suit application; galvanized or stainless for exterior and high humidity locations; plain finish at other locations.
- C. Edge Banding: Edge banding shall be 3 mm thick x 1-5/8 inch strip banding of ABS/PVC composition by Wilsonart, or equivalent.
 - 1. Color: PL-11 as described below.

2.6 ARCHITECTURAL SLAT WALL PANEL

- A. Description: As assembled by Owner's preselected supplier. EPVC substrates clad with machine-pressed vinyl to form rigid, preformed panel with linear wood-slat appearance. Dimensions as determined by supplier.
- B. Supplier: Architectural Slat Wall Panel: Procure slat wall from HJC as Owner's pre-selected supplier. Contact Haines, Jones & Cadbury, (800) 459-7099, WMT@hjcinc.com.
 - 1. Slat wall is a custom architectural panel, fully assembled off site and shipped as a panel unit by Owner's supplier.

2.7 COLOR/PATTERN SCHEDULE

- A. Provide one color where two or more are specified. Provide laminate specified below as applicable and as shown/scheduled on the Drawings. All PL designations are for HPL unless otherwise indicated. Colors shown in parentheses are generic color names.
 - 1. PL-11 (Medium Gray):
 - a. No. 928-58 Mouse (matte finish), by Formica.
 - b. No. D90-60 North Sea, by Wilsonart.
- B. Substitutions: Not permitted.

2.8 PLASTIC LAMINATE CASEWORK

- A. Fabricate using following materials for listed surfaces as defined in AWI/AWMAC/WI - Architectural Woodwork Standards.
 - 1. Plastic Laminates and Thermofused Melamine (TFM) panels with woodgrain patterns:
 - a. Grain direction to run vertical on vertical exposed millwork surfaces, including but not limited to cabinet faces, end panels, doors, drawer fronts, dividers and fillers, unless noted otherwise.
 - b. Grain direction to run parallel to face or exposed edges on horizontal surfaces including but not limited to cabinet bottoms, shelving and horizontal partitions.
 - 2. Exterior Exposed Surfaces (cabinet faces, ends and finished backs, doors, drawer fronts): High pressure or thermoplastic laminate as shown. Colors as indicated on Drawings.
 - 3. Interior Exposed Surfaces (open shelving storage or shelving areas): Thermofused Melamine (TFM), high

- pressure laminate, or thermoplastic laminate as shown. Color as indicated on the Drawings.
- 4. Semi-Exposed Surfaces (spaces behind doors, drawer boxes): Thermofused Melamine (TFM) , high pressure laminate, or thermoplastic laminate as shown. Color as indicated on Drawings.
- 5. Concealed Surfaces: Mill option using materials specified in this Section.
- 6. Base: 3/4" plywood or 2x wood blocking as indicated on Drawings.
- 7. Hardwood Edge Trim: Solid hardwood, optional species, for countertop edges as indicated on Drawings.
- 8. Panel Product Substrate for Laminate Clad Casework: Medium Density Fiberboard (MDF) or Particleboard as specified in Panel Product paragraph above.

B. Cabinet Hardware:

1. Base Cabinets:

- | | | | |
|----|-------------------------|------------------------------------|-------------|
| a. | Drawer Slides | Knape & Vogt (KV) | 1300 |
| b. | Drawer Lock | KV | 986 NP |
| c. | Drawer Gang Lock System | Selby Furniture Hardware Co., Inc. | L-3CTRDSK U |
| d. | Shelf Standards | KV | 255ZC |
| e. | Shelf Supports | KV | 239 |

2. Doors:

- | | | | |
|----|------------------|------------------|---------------------|
| a. | Wire Pull | EpcO | EPC-MC402-3-BRC 626 |
| b. | Door Lock | KV | 986 NP |
| c. | Hinges | Rockford Process | IH 860 |
| d. | Magnetic Catches | Ives | 325 (A 92) |

- C. Fasteners: Unless otherwise recommended by the manufacturer, use size and type to suit application; galvanized or stainless for exterior and high humidity locations; plain finish at other locations.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install items specified herein where and as shown on the Drawings.

3.2 PLASTIC LAMINATE CASEWORK

- A. Where new plastic laminate is indicated for existing casework, remove existing laminate and/or finishes to base substrate prior to installation of new. Installation of new laminate over existing is not acceptable, no exceptions.
- B. Install woodwork plumb, level, and straight without distortion; use concealed shims. Scribe and cut woodwork to fit adjoining work. Anchor woodwork items to nailers or blocking or directly to substrate using concealed fasteners.
- C. Casework: Provide well fitting and smooth operating doors and drawers.
- D. Countertops: Anchor plastic laminate countertops securely to base units.
- E. Install laminate on vertical surfaces with directional pattern or grain oriented vertically. Install laminate on horizontal surfaces with directional pattern or grain oriented parallel to length of countertop.

3.3 ARCHITECTURAL SLAT WALL PANEL

- A. Examine surfaces and adjacent areas where slat wall panel will be installed and verify that substrates are flat, clean, dry, solid, and free from coatings and defects detrimental to installation.
- B. Remove existing rigid sheet wall coverings to base substrate prior to installation of slat wall panel.
- C. Download and use the [Slat Wall Panel Installation Guide](#).
 - 1. Begin with the starter edge and assemble overlapping panels as shown in the Installation Guide. Cut the final assembly to fit openings and wall requirements.

- D. Attach slat wall panel to flat building wall surface at location shown on Drawings.
1. Gypsum Board Substrate: Attach directly to gypsum wall using the Franklin construction adhesive specified herein. Use drywall screws to fasten in recesses of slats at panel joints and in pre-drilled holes in edge panels.
 2. Split Face CMU Substrate or Irregular Wall Surface: Vertical plain may vary. If necessary to achieve flat attachment surface, use 7/8-in. hat furring channel on building wall surface.

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END OF SECTION

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SECTION 06610 - GLASS FIBER REINFORCED PLASTIC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: FRP plastic coated panels and accessories.
- B. Related Requirements:
 - 1. Section 01600 - Product Requirements: Contractor's Product Selection Checklist.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM D 256 - Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - 3. ASTM D 638 - Test Method for Tensile Properties of Plastics.
 - 4. ASTM D 790 - Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Store in clean, dry, enclosed, and secure storage area. Store flat on supplier's original shipping palettes and in accordance with manufacturer's published requirements.
- C. Protect adhesive from freezing temperatures, excessive heat, temperature fluctuations, humidity and moisture penetration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of FRP products and accessories specified herein shall be one of the following:
 - 1. Crane Composites, Inc, Channahon, IL, (800) 435-0080.
 - 2. Glasteel, Moscow, TN, (800) 238-5546.
 - 3. Franklin International, Columbus, OH, (800) 877-4583 (adhesive and sealants only).
 - 4. Marlite, Dover, OH, (800) 377-1221.
 - 5. Parkland Plastics, Inc., Middlebury, IN ((800) 835-4110 (adhesive only).
 - 6. Spray-Lock Premium Eco Adhesives, Chattanooga, TN ((423) 305-6151 (adhesive only).

2.2 SUPPLIERS

- A. Specified products may be procured from the following suppliers:
 - 1. Contractor Supply Network, Louisville, KY (888) 289-9950.
 - 2. Foundation Building Materials, Tustin, CA, (714) 380-3127. Multiple locations across US.
 - 3. Grainger.
 - 4. GTS Interior Supply, Kirkland, WA (425) 828-6761.
 - 5. Haines, Jones and Cadbury, Bentonville, AR, Customer Service: (800) 459-7099, wmt@hjcinc.com.
 - 6. The Home Depot.
 - 7. Kal-Lite (Division of Kalwall Corporation), Bow, NH, (800) 526-1609.

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- 8. True Value Hardware.
- 9. US FRP, Indiana, PA, (844) 698-7377.

2.3 FIBERGLASS REINFORCED PANELS (FRP)

- A. Description: Fiber reinforced plastic coated panels, 0.09 inch thick.
- B. Physical Characteristics: Meet the following minimum characteristics:
 - 1. Flexural Strength: 8,500 psi per ASTM D 790.
 - 2. Tensile Strength: 5,000 psi per ASTM D 638.
 - 3. Izod Impact Resistance: 4 ft-lb/sq inch per ASTM D 256.
 - 4. Surface burning characteristics in accordance with ASTM E 84 for Class C finish:
 - 5. Flame Spread: Less than 200.
 - 6. Smoke Density: Less than 450.
- C. United States Department of Agriculture (USDA): Approved for incidental food contact.
- D. Finish: Embossed.
- E. Color: Provide color specified below as shown on Drawings or equal by other manufacturer specified herein.

Designation	Crane Composites	Glasteel	Marlite
FRP 1	#85 White	WL White	P100 White

2.4 ACCESSORIES

- A. Adhesive: Pressure sensitive, low VOC adhesive.
 - 1. Titebond Greenchoice Advanced Polymer Panel Adhesive, by Franklin International.
 - 2. C-551 FRP Adhesive by Marlite.
 - 3. Parkland Panel Adhesive by Parkland.
 - 4. FRP Spray Adhesive, by Spray-Lock Premium Eco Adhesives.
- B. Wall Trim: Manufacturer’s standard matching wall trim including caps, division bars, inside and outside corners, edge, and other trim as required for a complete and finished installation.
- C. Sealant: Manufacturer's Silicone Construction Sealant.
 - 1. Product: MS 250 or MS 251 Silicone Sealant by Marlite or equivalent by any listed manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas where products will be installed and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of installation indicates acceptance of substrate conditions.

3.2 PREPARATION

- A. Where new FRP wall panels are to be installed, remove existing wall panels and/or finishes to base substrate prior to installation of new. Installation of new wall panels over existing is not acceptable, no exceptions.
- B. Prepare substrate for product installation in accordance with manufacturer's published instructions.

3.3 INSTALLATION

A. FRP Panels:

1. Install FRP wall panels in accordance with manufacturer's published instructions.
2. Prefit each wall panel before securing in place. Cut panels with carbide-tipped power saw or swivel-head shear.
3. Provide manufacturer's recommended spacing between abutting panel ends, edges and trim. Provide minimum 1/8 inch space around pipes, electrical fittings, obstructions and other items penetrating panels. Fill joints with sealant.
4. Install panels with edges vertical and plumb. Use maximum length pieces to provide minimum number of end joints.
 - a. Align panel to panel vertical joints at inside and outside corner conditions.
5. Substrate: Apply adhesive to substrate and to panel backs as recommended by manufacturer with V-notch spreader. Provide 100 percent coverage of adhesive.
6. Install accessory panel trim pieces concurrently with installation of panels. Miter cut accessory panel trim at corners to provide smooth transition. Set trim attached to adjacent panel ends and edges and seal with sealant.
7. Seal corner seams, base and ceiling junctures, and junctures between panels and wall with sealant. Remove excess sealant during installation.
8. Provide sealant around all openings, corners, and joints.

3.4 FIELD QUALITY CONTROL

- #### A. Inspect installation, accessories, and fastening to substrate.

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END OF SECTION

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SECTION 06616 - SIMULATED STONE FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Simulated stone countertops, surfacing, and accessory materials.
 - 2. Substrate for simulated stone countertops.
- B. Related Requirements
 - 1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 - 2. Section 06100 - Rough Carpentry: Fire retardant treatment for plywood countertop substrate.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- C. Department of Commerce (National Institute of Standards and Technology) – Product Standard (DOC):
 - 1. DOC PS 1 - Construction and Industrial Plywood.
- D. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.
- E. National Sanitation Foundation / American National Standards Institute (NSF/ANSI):
 - 1. NSF/ANSI 51 – Food Equipment Materials.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

1.4 INSTALLER QUALIFICATIONS

- A. Installers of simulated stone countertops shall be factory-trained.
- B. Installers of simulated stone countertops shall have no less than 2 years of prior experience in the installation of simulated stone materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with provisions of Section 01600.
- B. Require simulated stone countertop supplier to provide Shipping List of countertops and related items shipped and including Facility number and project location (city and state) and installed location of each countertop (room name and number).
- C. Store simulated stone materials to prevent breakage and marring of surfaces in accordance with manufacturer's printed instructions.

- D. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

PART 2 - PRODUCTS

- A. Provide simulated stone materials by the following manufacturer:
 - 1. LG Hausys USA, www.lghausysusa.com
- B. Substitutions: Comply with the requirements of Section 01600.

2.2 REGULATORY REQUIREMENTS

- A. Simulated stone countertops shall comply with the following requirements:
 - 1. ASTM E 84:Class A.
 - 2. United States Department of Agriculture (USDA): Approved for incidental food contact.
 - 3. NSF/ANSI 51.

2.3 COUNTERTOP SURFACING MATERIALS

- A. Type 1: HI-MACS Countertop Surfacing by LG Hausys USA: Classic Collection, Group B, solid surface material:
 - 1. Thickness: 1/2" inch
 - 2. Color: G015 Midnight Pearl.
- B. Countertop and Backsplash Profiles.
 - 1. Countertop: Solid slabs with 1 1/2" turn down with 1/4" rounded top edge at exposed front and sides, and overall counter size per Drawings,
 - 2. Backsplash: Separate solid units installed on top of counter, size and location per Drawings.

2.4 COUNTERTOP SUBSTRATE

- A. Provide the following substrate for simulated stone countertops at locations indicated on Drawings:
 - 1. Plywood DOC PS 1 Type 1 (Interior): Grade C-D Plugged veneer plywood, Exposure I.
 - 2. Thickness as indicated on the Drawings.
 - 3. Provide plywood treated with fire retardant specified in Section 06100.

2.5 ACCESSORIES

- A. Supply materials for installation of products as specified in manufacturer's printed installation instructions including color matched silicone sealant and adhesives where applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas where products will be installed and verify that surfaces conform to product manufacturer's requirements for substrate conditions.

3.2 PREPARATION

- A. Prepare substrate surfaces to receive simulated stone materials in accordance with manufacturer's printed instructions.

3.3 INSTALLATION

- A. Use tools, techniques and procedures recommended by simulated stone countertop manufacturers specific to their materials for field fabrication and installation.
- B. Install components plumb and level in accordance with manufacturer's written recommendations.

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- C. Fabricate seams and fixture mounting in accordance with manufacturer's written recommendations.
- D. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
- E. Lay out and field cut countertops using templates provided by component suppliers for field adaptation and as required for field cuts and holes for equipment shown on Drawings to be installed later.
- F. Use blades, saws and drill bits recommended by manufacturer. Provide blades and saws as recommended by manufacturer to maintain dust emissions below the permissible level.
- G. Clean dust and debris from cuts and holes using a HEPA-rated filter vacuum.
- H. Provide backsplashes and endsplashes as indicated on Drawings. Adhere to countertop using manufacturers standard color matched silicone sealant.
 - 1. Provide a smooth continuous cove of sealant free of voids and neat in appearance at bottom, top and vertical corners.

3.4 CLEANING

- A. Remove adhesives, sealants, and other stains upon completion of installation per manufacturers written instructions.
- B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

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END OF SECTION

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SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermal Batt Insulation.
 - 2. Sound Attenuation Insulation (Sound Batts).
- B. Related Sections:
 - 1. Section 07500 – Membrane Roofing: Isocyanurate Foam Insulation.
 - 2. Section 09250 - Gypsum Board: Metal furring.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM C 665 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 3. ASTM C 991 - Specification for Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings (If Specified).
 - 4. ASTM E 136 - Behavior of Materials in a Vertical Tube Furnace at 750° C.

1.3 DEFINITIONS

- A. Concealed Insulation: Insulation concealed within framing system, both faces protected by finish material.
- B. Exposed Insulation: Insulation exposed within framing system, one or both faces unprotected.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from one of the following manufacturers as specified in the Materials paragraph below:
 - 1. CertainTeed Corporation, Valley Forge, PA (800) 523-7844.
 - 2. Guardian Fiberglass Incorporated, Albion, MI (800) 748-0035.
 - 3. Johns Manville Insulations, Denver, CO (800) 654-3103.
 - 4. Owens-Corning, Toledo, OH (800) 438-7465.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics and other methods specified. Identify materials with appropriate markings of applicable testing and inspecting agency.

2.3 MATERIALS

- A. Batt Insulation: ASTM C 665 mineral fiber blanket insulation.
 - 1. Unfaced Glass Fiber: Type I (blankets without membrane facing); with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively passing ASTM E 136 for combustion characteristics.
 - 2. Faced, Glass-Fiber: Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with vapor-retarder membrane on 1 face.
 - 3. Sound Attenuation Insulation (Sound Batts): Unfaced glass fiber insulation as specified above.
 - 4. Provide batt insulation by one of the following manufacturers:
 - a. CertainTeed Corporation.
 - b. Guardian Fiberglass, Inc.
 - c. Johns Manville.
 - d. Owens Corning.
- B. Substitutions: Comply with the requirements of Section 01600.

2.4 ACCESSORIES

- A. Tape: Polyethylene or polyester self-adhering type; two inches wide.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Batt Insulation:
 - 1. Verify adjacent materials are dry and ready to receive installation.
 - 2. Verify mechanical and electrical services within walls have been installed and tested.

3.2 INSTALLATION - BATT INSULATION

- A. Install batt insulation in accordance with manufacturer's instructions, without gaps or voids.
- B. Trim insulation neatly to fit spaces. Use batts free of damage. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- C. Install insulation with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane. Attach insulation in place to framing; tape seal butt ends and lapped side flanges. Tape seal tears or cuts in membrane.

3.3 INSTALLATION - INSULATION AT EXTERIOR MASONRY WALLS

- A. Install insulation as shown on the Drawings.

3.4 SCHEDULES

- A. Provide insulation types as scheduled below and as indicated on Drawings.

CONDITION	TYPE OF INSULATION	THICKNESS
Exterior Wall, Soffits, & Ceiling	Faced Batt Insulation	3-1/2 inches (R=13) or 6 inches (R=19) as shown; or as required to fill cavity.
Interior Partitions	Unfaced Batt Insulation	3-1/2 inches or 6 inches as Shown.
Sound Attenuation	Unfaced Batt Insulation	3-1/2 inches or 6 inches as Shown.

END OF SECTION

SECTION 07252 (07 2726) - FLUID-APPLIED MEMBRANE AIR BARRIER – Add Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Fluid applied, vapor permeable air barrier membrane system for installation on substrate behind exterior wall panels.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 07430 – Composite Wall Panels: Aluminum-faced composite wall panels.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C 920 - Elastomeric Joint Sealants.
 - 2. ASTM C 1193 - Joint Sealants.
 - 3. ASTM D 4258 - Surface Cleaning Concrete for Coating.
 - 4. ASTM D 4263 - Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 5. ASTM E 162 - Test Method for Surface Flammability of Materials Using a Radiant Heat Source.
 - 6. ASTM E 1186 - Air Leakage Site Detection in Building Envelopes and Air Retarder Systems.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Air barrier systems shall be manufactured and marketed by a firm with a minimum of 20 years' experience in the production and sales of waterproofing and air barriers.
- B. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Deliver materials and products in labeled packages. Protect products from damage due to sunlight, weather, excessive temperatures and construction operations.
- C. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
- D. Protect from freezing and extreme heat.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply air barrier to a wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 AIR BARRIER

- A. Air Barrier Membrane: Fluid-applied, fully-adhered, vapor-permeable, single component acrylic membrane air barrier. NFPA 285, ASTM E 2357. Provide the following or equivalent product by other manufacturers:
1. [Perm-A-Barrier VPL](#) by GCP Applied Technologies (formerly GPC), Cambridge, MA, (866) 333-3726.

2.2 MATERIALS

- A. Liquid Membrane for Details and Terminations: [Bituthene Liquid Membrane](#) by GPC.
- B. Wall Primer (for Use with Throughwall Flashing and Tapes Applied to Substrate): Liquid waterborne primer.
1. Product: [Perm-A-Barrier WB Primer](#) by GPC.
- C. Flexible Membrane Wall Flashing: 32 mils of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a min. 40 mil thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed
1. Product: [Perm-A-Barrier Wall Flashing](#) by GPC.
- D. Joint Reinforcing Strip: Air barrier manufacturer's approved tape.
- E. Transition Membrane: 32 mils of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a min. 40 mil thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed.
1. Product: [Perm-A-Barrier Wall Flashing](#) GPC.
- F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
1. Product: [Bituthene Liquid Membrane](#) by GPC.
- G. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- H. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 4. Verify that masonry joints are struck flush and completely filled with mortar.
 5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the fluid-applied air barrier system.

- B. Exterior Sheathing Panels: Stabilize panels with corners and edges fastened with appropriate screws. Pre-treat board joints with 2-3 in. wide, manufacturer's recommended self-adhesive tape. Fill gaps greater than 1/4 in. with mastic or caulk, allowing sufficient time to fully cure before application of the tape and fluid applied air barrier system.
- C. Masonry Substrates: Apply air barrier over concrete block and brick with smooth trowel-cut mortar joints, struck full and flush. Fill voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout, or parge coat.
- D. Treat construction joints and install flashing as recommended by manufacturer.
- E. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- F. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- G. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- J. At changes in substrate plane, apply sealant or Bituthene Liquid Membrane at sharp corners and edges to form a smooth transition from one plane to another.
- K. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces. Prime substrate as required.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C1193 and with air barrier manufacturer's written instructions. Apply tape to joint prior to installing fluid air barrier membrane.

3.4 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
 1. 90-mil wet film thickness, 45-mil dry film thickness.

3.5 TRANSITION MEMBRANE INSTALLATION

- A. Install strips, transition membrane, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
 3. Install all flashings only after application of air barrier.

- B. Apply primer to substrates to receive transition membrane at required rate and allow to dry. Limit priming to areas that will be covered by transition tape in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing not covered with air membrane material with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches) of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
 - 1. Transition Membrane: Roll firmly to enhance adhesion.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.6 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 150 days.
- C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Remove masking materials after installation.

END OF SECTION

SECTION 07421 – EXTERIOR INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Laminated steel insulated exterior metal wall panels.
 - 2. Accessories including fasteners and perimeter trim.

1.2 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
- B. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7: Minimum Design Loads for Buildings and Other Structures
- C. ASTM International
 - 1. ASTM A755: Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
 - 2. ASTM A792: Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - 3. ASTM A924: General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.3 SUBMITTALS

- A. Submit in accordance with the requirements of Section 01330.
- B. Product Data: Submit manufacturer current technical literature for each type of product.
- C. Shop Drawings: Submit detailed drawings showing:
 - 1. Profile.
 - 2. Gauge of both exterior and interior sheet.
 - 3. Location, layout and dimensions of panels.
 - 4. Location and type of fasteners.
 - 5. Shape and method of attachment of all trim.
 - 6. Locations and type of sealants.
 - 7. Installation sequence.
 - 8. Coordination Drawings: Provide elevation drawings and building sections which show panels in relationship to required locations for structural support. Include panel details and details showing attachment to structural support.
 - 9. Other details as may be required for a weathertight installation.
- D. Manufacturer Erection Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, and maintenance instructions.
- E. Panel Analysis: Provide panel calculations to verify panels will withstand the design wind loads indicated by the AHJ without detrimental effects or deflection exceeding the specified limit. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.
- F. Quality Assurance Submittals
 - 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with the requirements of the AHJ.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company approved and certified by the panel manufacturer and demonstrating a minimum 5 years' experience performing Work of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect products.
- B. Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.
- C. Store wall panel materials on dry, level, firm, and clean surface. Stack no more than two bundles high. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.

1.1 WARRANTY

- A. Manufacturer's standard performance and finish warranties.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Provide Insulated Wall Panel System by Metal-Span (a Nucor company).

2.2 EXTERIOR WALL PANELS

- A. Panel Assembly: Steel exterior face structurally bonded to insulated foam core panels with integral vapor barrier; folded exterior face corners; attached by concealed fasteners and clips.
 - 1. Panel thickness: 3 inches thick.
 - 2. Exterior Face of Panel: Coil material in accordance with ASTM A755 Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924, 26 gauge steel.
 - a. Profile: Flat. CF-Flute.
 - b. Exterior Texture: Smooth.
 - c. Exterior Finish: 1.0 mil. Fluoropolymer (PVDF) Two Coat system: 0.2 mil primer with 0.8 mil Kynar 500 (70 percent) solid color coat.
 - 1) Color: As indicated on Drawings.
 - 3. Interior Face of Panel: Coil material Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924, 26 gauge steel.
 - a. Profile: Standard flat, non-profiled
 - b. Interior Texture: Smooth
 - c. Interior Finish: Modified polyester finish with a total minimum dry film thickness of 0.9 to 1.1 mil including primer.
 - 1) Color: White
 - 4. Insulating Core: Precured, profiled, sanded flat, polyisocyanurate core material.
 - 5. Structural Adhesive: Type II Class 2 Structural Urethane Adhesive.
- B. Provide CF-Flute Wall Panel System by Metal-Span (a Nucor company).
- C. Substitutions: Comply with the requirements of 01600.

2.3 ACCESSORIES

- A. Fasteners (by Panel Manufacturer): Fasteners as recommended by manufacturer.
- B. Clips (by Panel Manufacturer): Shall be minimum 14 gauge half-hard type 301 stainless steel with PVC or neoprene foam sealing pad adhered to underside of clip, designed to prevent water infiltration around fastener penetrations.

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- C. Perimeter Trim (by Panel Manufacturer):
 - 1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal wall panel.
- D. Butyl Weather Barrier Sealant (by Contractor): Non-skinning butyl tube sealant per panel manufacturer's recommendations compliant with AAMA 809.2.
- E. Sealants at exposed joints (by Contractor): Elastomeric polyurethane sealant compliant with ASTM C920.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Provide field verified measurements for installation tolerances and report deviations as necessary to the General Contractor and Designer of Record.
- B. Supporting Steel: By others, refer to Section 05120.
 - 1. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and horizontal joints of vertical panel systems. Width of support as recommended by manufacturer.
- C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.2 PREPARATION

- A. Broom clean substrate deck surfaces immediately before starting installation.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written installation guidelines and recommendations.
- B. Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.
- C. Cut panels prior to installing where indicated on drawings using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions. Ventilate area where polyurethane dust is generated.
- D. Butyl Weather Barrier Sealant:
 - 1. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
 - 2. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
 - 3. Do not use non-skinning butyl tube sealant to bridge gaps.
- E. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the approved shop drawings.

3.4 TRIM INSTALLATION

- A. Place trim and trim fasteners only as indicated per details on the approved shop drawings.
- B. Field drill weep holes where appropriate in horizontal trim; minimum 1/4 inch diameter at 24 inches on center.
- C. Place a continuous strip of butyl tape or butyl tube sealant on closure trims for the length of the panel to be covered by trim.

3.5 SEALANT INSTALLATION FOR EXPOSED JOINTS

- A. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.
- B. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.
- C. Direct contact between butyl and silicone is not permitted.

3.6 CLEANING AND PROTECTION

- A. Remove protective film immediately after installation.
- B. Touch-up, repair or replace metal panels and trim that have been damaged.
- C. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07430 (07 7243) – ALUMINUM FACED COMPOSITE WALL PANELS (ACM) – Add Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Aluminum-faced composite wall panels.
- B. Related Requirements: The following list of items is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 07252 – Fluid-Applied Membrane Air Barrier.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM D 2244 - Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 3. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 - 4. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors under the Influence of Wind Loads.
 - 5. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- C. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 620 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 01330.
- B. Shop Drawings: Indicate layout, profiles, product components, and construction, include edge conditions, panel joints, anchorage, accessories, finish colors, patterns, and textures. Show manufacturer's recommended joint details providing watertight and structurally sound wall panel system that prevents uncontrolled water penetration on the inside face of the panel system as determined by ASTM E 331.
- C. Manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- A. Installer's Qualifications: Minimum 5 years' experience in architectural metal panel work similar in scope and size to this project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
1. Wind Loads: Determine loads based on the following minimum design wind pressures: Uniform pressure of 20 lbf/sq. ft. acting inward or outward.
 2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span.

2.2 MANUFACTURER

- A. [Arconic Architectural Products LLC](#), Eastman, GA. Contact (800) 841-7774 or (478) 374-4746.

2.3 PRODUCTS

- A. Provide [Reynobond Aluminum Composite Material](#) panels and system (ACM) by Arconic.
- B. Panel Description: Two face sheets of fire-resistant aluminum over a solid core of extruded thermoplastic material formed in a continuous process.
1. Aluminum Sheet: 3000 series aluminum alloy.
 2. Surface: Smooth, flat finish.
 3. Core: Manufacturer's standard polyethylene (PE) core.
 4. Panel Thickness: RB160FR 4 mm.
 5. Finish: 2-coat, coil-coated polymer resin or Kynar finish, bottom side coated with manufacturer's standard wash coating.
 6. Color: Provide the following where shown:
 - a. PF-11: White: Reynobond Duragloss 5000 Brite White by Arconic.
 - b. PF-14: Walmart Blue: Match P76U Walmart Blue in Reynobond Duragloss 5000 by Arconic

2.4 WEATHER BARRIER

- A. Provide fluid-applied membrane weather resistive barrier as specified in Section 07252 and accessories as recommended by the manufacturer.

2.5 FABRICATION

- A. Provide ACM panel system fabricated and finished according to manufacturer's standard procedures and to the following requirements:
1. Joints formed to provide weathertight seals.
 2. Panel system fabricated to dimension, size, and profile indicated on the drawings allowing for field adjustment and thermal movement.
 3. Verify panel bow is limited to 0.8% of panel overall dimension in width or length.
- B. Apply strippable film to the top side of the painted coil to protect the finish during fabrication, shipping, and field handling.

2.6 ACCESSORIES

- A. Extrusion Formed Members, Sheet and Plate: Conform to ASTM B 209 and manufacturer's recommendations.
- B. Panel Stiffeners: Structurally fastened or restrained at the ends and secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and finish shall be compatible with the silicone.

- C. Joint Sealants: As required by panel system manufacturer.
- D. Flashing Materials: 0.040 inch minimum thickness aluminum sheet provided by panel manufacturer to match the adjacent panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bead of non-hardening sealant.
- E. Fasteners: Concealed, non-corrosive fasteners as recommended by system fabricator and installer.

2.7 SUBSTITUTIONS

- A. Comply with the requirements of Section 01600.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Framing: Install miscellaneous wall panel support members and anchorage according to panel manufacturer's written instructions.

3.2 INSTALLATION

- A. Anchor panels securely per engineering recommendations and in accordance with shop drawings to allow for necessary thermal movement and structural support.
- B. Conform to panel fabricator's instructions for installation of concealed fasteners.
- C. Provide field adjustment and minimal fabrication only as necessary to adapt to field conditions.
- D. Maximum deviation from vertical and horizontal alignment of erected panels shall be 1/4 inch in 20 feet, non-accumulative.

3.3 ACCESSORY INSTALLATION

- A. Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions.
- C. Weather Barrier: Install weather barrier and accessories in accordance with manufacturer's written instructions.

3.4 CLEANING

- A. Remove temporary protective coverings and strippable films as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by panel manufacturer.
- B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

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END OF SECTION

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SECTION 07500 (07 5000) - MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. TPO Membrane Roofing System including insulation.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 06100 - Rough Carpentry: Wood blocking and nailers.
 - 2. Section 07620 - Sheet Metal Flashing and Trim: Sheet metal counter flashings, and other sheet metal.
 - 3. Section 07710 – Manufactured Roof Specialties: Roof edge fascia system.
 - 4. Section 07711 - Gutters and Downspouts: Interface of gutters with roofing and metal flashings.
 - 5. Section 07900 - Joint Sealers.
 - 6. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C 578 - Rigid, Cellular Polystyrene Thermal Insulation.
 - 2. ASTM C 1177 - Glass Mat Gypsum Substrate for Use as Sheathing.
 - 3. ASTM C 1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 4. ASTM C 1303 - Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation.
 - 5. ASTM D 6878 - Thermoplastic Polyolefin Based Sheet Roofing.
- C. Factory Mutual Research Corporation (FM):
 - 1. FM Approvals Building Materials Approval Guide, Chapter 3 - Approved Combinations and Assemblies.
 - 2. FM Global Loss Prevention Data Sheet 1-28 - Design Wind Loads.
 - 3. FM Global Loss Prevention Data Sheet 1-29 - Roof Deck Securement and Above-Deck Components.
 - 4. FM Approval Standard 4450 - Class 1 Insulated Steel Deck Roofs.
 - 5. FM Approval Standard 4470 - Class 1 Roof Covers.
- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL - Roofing Materials and Systems Directory.
 - 2. UL 1256 - Fire Test of Roof Deck Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Conference:
 - 1. Plan, host, and attend Pre-Installation Meeting via teleconference.
 - 2. Schedule teleconference between 5 and 7 days prior commencing work of this Section.
 - 3. Attendees shall be parties and persons directly affecting work of this Section, are in the direct line of supervision, and who will be physically present at the site. Attendees shall include, but not be limited to the following:
 - a. Owner's Roofing Consultant.
 - b. Owner's Construction Manager.
 - c. General Contractor.
 - d. Roofing sub-contractor (Roofing Applicator and job foreman).

- e. Mechanical and Plumbing sub-contractors.
- f. Manufacturer's Technical Representative.
- g. Owner's Construction Testing Laboratory (CTL).
- 4. Notify all required attendees in writing of scheduled time and place at least two weeks in advance of meeting. Include copy of agenda with invitation.
- 5. The meeting shall be conducted by Owner's Roofing Consultant.
- 6. The meeting shall convene only when all parties are present.
- 7. Review foreseeable methods and procedures related to roofing work, including the following:
 - a. Discuss condition of substrate, roof drains, roof drain final locations, curbs, penetrations and other preparatory work performed by other trades.
 - b. Identify any conduits located beneath the roof deck so as to develop a work plan to prevent damage to the electrical wiring during insulation and membrane fastener installation.
 - c. Review structural loading limitations of deck as defined below and inspect deck for loss of flatness and for required mechanical fastening.
 - d. Review roofing system requirements (drawings, specifications and other contract documents including submittals).
 - e. Review preparation and installation procedures and coordinating and scheduling required with related work.
 - f. Review required submittals. Submittals shall be reviewed and approved by the Roofing Consultant prior to the Pre-Installation Conference.
 - g. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - h. Establish lines of communication between Contractor, Roofing Consultant, and Store Manager.
 - i. Review required inspections, testing, certifying, and material usage accounting procedures.
 - j. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
 - k. Review site specific conditions.
 - l. Review Contractor's safety and fall protection plans.
- 8. Meeting Minutes: Contractor shall record minutes of meeting including discussions, decisions and agreements reached, and attendance roster. Furnish a copy to each party attending.
- 9. Changes to Contract Documents from recommendations or discussions at the Pre-Installation Conference shall be approved in writing by Owner's Construction Manager prior to implementation.

B. Prior to the roofing subcontractor arriving on site, Contractor shall give notice in writing to the roofing subcontractor that the Owner's Construction Testing Laboratory (CTL) has completed its Testing and Inspections (T&I) of the roof deck and that the deck is in conformance with the contract documents.

C. Manufacturer' Inspection Reports:

- 1. Periodic Inspection Reports: Obtain manufacturer's technical representative's periodic inspection reports as specified in Part 3 herein and submit to Roofing Consultant prior to Consultant's inspection.
- 2. Comprehensive Final Roof Inspection Report: Obtain Manufacturer's Comprehensive Final Roof Inspection Report as specified in Part 3 herein and submit to the Roofing Consultant as soon as possible prior to Substantial Completion.

D. Upon completion of roofing construction, Contractor shall contact the Roofing Consultant to coordinate Consultant's inspection.

1.4 SUBMITTALS

- A. Comply with the requirements of Section 01330. Submit required submittals within 30 days after contract award. Submittals shall be available at all times to the Owner's Construction Manager.
- B. Submittal Packet: Submittal Packet shall include the following
 - 1. Fastener patterns to meet uplift requirements.
 - 2. Layouts for Crickets and saddles.
 - 3. Project or region-specific details required for completion but not shown on Drawings.
 - 4. Techniques for nighttime or weather tie offs.

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5. Completed Manufacturer's Pre-Installation Notice included at the end of this Section or Manufacturer Order Form.

- C. Closeout Submittals: Comply with the requirements of Section 01770.
1. Roofing System Warranty Form included at the end of this Section.

1.5 QUALITY ASSURANCE

- A. At the completion of Work, remove loose materials on the roof surface which may cause damage to the roof membrane or restrict water flow to roof gutters, drains, or scuppers.
- B. Roofing Consultant: The Roofing Consultant is a consultant hired by and contracted by the Owner for the purpose of assurance and verification of roofing installation in accordance with the Contract Documents. Testing and inspection by the Roofing Consultant is specified in Appendix B (Section 07500).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Deliver materials in manufacturer's original unopened containers, dry and undamaged with seals and labels intact.
- C. Store materials in weather-protected environment, clear of ground and moisture. Storage requirements for insulation are as follows:
1. Cover with tarpaulin, shield from moistures and ultraviolet rays.
 2. Elevate minimum of 4 inches above substrate.
 3. Secure to resist high winds.
 4. Distribute insulation stored on roof deck to prevent concentrated loads.
 5. Do not install wet insulation. Insulation shall be thoroughly dry prior to installation.
- D. Store cements, primers, and caulks in heated area above 40 degrees F during cold weather and in area below 80 degrees F in warm weather.
- E. Do not store materials on completed roofing.

1.7 PROJECT CONDITIONS

- A. Follow industry standards for environment requirements including, but not limited to, the following:
1. Do not apply roofing membrane during inclement weather. When air temperature is expected to fall below 40 degrees F, follow specified Cold Weather Application Procedures as specified herein.
 2. Do not apply finished roofing system to wet, damp or frozen deck surface or when precipitation is occurring.
 3. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.
 4. Maintain bonding adhesive at a min of 60 degrees prior to application.

1.8 WARRANTY

- A. Provide Warranty commencing at date of Project completion, on form provided at the end of this Section that includes cost of labor and materials for loss of weather tightness without financial limit for a period of 15 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements and to the extent specified hereinafter, provide products by the following manufacturers:
1. [Carlisle SynTec](#), Steve Benjamin, Technical Manager, Strategic Accounts Group, (413) 262-8928
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2. steven.benjamin@syntec.carlisle.com.
2. [Firestone Building Products Company](#), Indianapolis, IN, Jason Flack, National Accounts Representative, (317) 816-3989, flackjason@firestonebp.com
3. [Johns Manville Roofing Systems](#), A. J. Maijala, Manager, Preferred Accounts (303) 978-2176 or (303) 898-0027, aj.maijala@jm.com.
4. [GAF](#), Rich Justinn, Strategic Accounts Manager, (678) 920-9237, richard.justinn@gaf.com.

2.2 SYSTEM DESCRIPTION

- A. Single Ply Membrane Roofing System: Single ply membrane roofing system consisting of insulation on metal deck with reinforced membrane mechanically fastened.
- B. Flashing and Waterproofing Membranes: Reinforced membrane and unreinforced, fully adhered, as defined herein and indicated on Drawings.

2.3 REGULATORY REQUIREMENTS

- A. Roof Assembly: Comply with Factory Mutual System Approval Guide or Underwriters Laboratories, Inc. Roofing Materials and Systems Directory as specified:
 1. Factory Mutual: Provide roofing assembly meeting Class 1A -60 requirements for fire resistance and wind uplift in accordance with Factory Mutual Approvals Standard 4470 and Factory Mutual Global Loss Prevention Data Sheet 1-28 and Factory Mutual Global Loss Prevention Data Sheet 1-29. 1A -90 requirements shall comply with the April 2010 version of Factory Mutual Approvals Standard 4470 in lieu of any later version.
 2. Provide roof assembly meeting requirements of UL 1256 for Flame Spread developed from underside of deck and roof assembly meeting requirements of Factory Mutual Approvals Standard 4450 for Class 1 Insulated Steel Deck Roofs (construction materials calorimeter).

2.4 ROOFING SYSTEMS

- A. Single Ply Mechanically Attached TPO Membrane Roofing System. Subject to compliance with requirements, provide one of the following products:
 1. Sure-Weld Roofing System by Carlisle.
 2. UltraPly TPO Roofing System by Firestone.
 3. JM TPO Mechanically Fastened Roofing System by Johns Manville.
 4. EverGuard TPO Roofing System by GAF.
- B. Substitutions: Comply with the requirements of Section 01600.

2.5 ROOF MEMBRANE

- A. Roof Membrane: Single ply membrane composed of thermoplastic polyolefin (TPO) sheet as specified for the specific product hereinbefore and reinforced with polyester scrim conforming to ASTM D 6878.
 1. Membrane Type: Reinforced, 60 mil thickness, white, 10 ft. maximum sheet width.
- B. Flashing Membrane: Reinforced and non-reinforced TPO membrane and pressure-sensitive flashing by Roofing System manufacturer, thickness to match roofing membrane, specifically designed for use in flashing at perimeters and around projections through roofing system.

2.6 WATERPROOFING MEMBRANE

- A. At Contractor's option, use TPO or EPDM waterproofing membrane and flashing as specified below.
- B. TPO System:
 1. Waterproofing Membrane: Membrane waterproofing composed of thermoplastic polyolefin (TPO) formed into uniform, flexible sheets by Roofing System manufacturer, thickness to match roof membrane.
 2. Waterproofing Flashing: Reinforced and non-reinforced TPO membrane and pressure-sensitive flashing by

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Roofing System manufacturer, thickness to match membrane, specifically designed for use in flashing at perimeters and wall, and around projections through roofing system.

- C. EPDM System:
 - 1. Waterproofing Membrane: Unreinforced cured single ply membrane composed of ethylene propylene diene monomer (EPDM) sheet as specified for the specific product hereinbefore.
 - a. Membrane Type: 60 mil thickness, black.
 - 2. Waterproofing Flashing: Reinforced and non-reinforced EPDM membrane and pressure-sensitive flashing by roofing system manufacturer, thickness to match membrane, specifically designed for use in flashing at wall.

2.7 ROOF INSULATION

- A. Isocyanurate Foam Insulation: Polyisocyanurate board insulation, ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces, with an LTTR (Long Term Thermal Resistance) value of 16.2 based on ASTM C 1303.
 - 1. Subject to compliance with requirements, provide one of the following products:
 - a. HPH by Carlisle.
 - b. ISO 95+ GL, by Firestone.
 - c. E'NRG'Y 3 or ISO 3 by Johns Manville.
 - d. EnergyGuard PolyIso Insulation by GAF.
 - e. Products meeting the specified requirements by other manufacturers as recommended by the roofing membrane manufacturer.
 - 2. Thickness: 2.8 inches min.
- B. Prefabricated EPS Tapered Insulation: Rigid expanded polystyrene (EPS) foam insulation, ASTM C 578, Type VIII (1.15 pcf minimum) or Type II (1.5 pcf minimum), flame retardant additive, with an LTTR (Long Term Thermal Resistance) value of 20.0 based on ASTM C 1303.
 - 1. Provide products meeting the specified requirements by one of the manufacturers specified above as applicable.
- C. Roof Curb Insulation: Polyisocyanurate Foam; both faces covered with glass fiber felt; thickness to match wood nailer.
- D. Contractor's Option: The following may be used:
 - 1. Hinged Target Sump: 8 ft x 8 ft, fabricated by roofing manufacturer, 0.5 – 2.5-inch panel thickness.

2.8 ROOF PENETRATION FLASHING

- A. Molded Pipe Flashing: Pre-molded flexible pipe flashing as recommended and supplied by the roofing manufacturer.

2.9 ACCESSORIES

- A. Provide accessories as shown on the drawings and manufacturer's system accessories for a complete and warranted Roofing System, including, but not limited to, the following:
 - 1. Weathered Membrane Cleaner.
 - 2. Lap Sealant.
 - 3. Bonding Adhesive.
 - 4. Termination Bar.
 - 5. Walkway / Isolation Pads.
 - a. Located around roof mounted equipment, roof hatches, cross-overs and at jib cranes.
 - 6. Preformed Accessories including pipe flashings.
 - 7. Preformed Corner Patching.
 - 8. Draw Bands.
 - 9. Foam Filler Insulation: Polyurethane Expanding Foam as specified in Section 07900.
 - 10. Pressure-sensitive Flashing.

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11. Primer.
12. Insulation and Membrane Fasteners.
13. In-seam Plates.
14. Splice Tape.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys, and eaves. Verify flutes of steel deck are evenly spaced at intersections. Defects in the substrate surface shall be reported and documented.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, nailing strips, and reglets are in place. Verify deck is supported and tightly secured.
- C. Verify deck surfaces are dry and free of water, snow, and ice.

3.2 PREPARATION

- A. Provide covers and other means of protection as necessary to protect building surfaces against damage during roofing work.
- B. Where Work shall continue over finished roof membrane, protect roof system from damage.

3.3 INSTALLATION

- A. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

3.4 ROOF INSULATION INSTALLATION

- A. Mechanically fasten insulation, through fire resistive layer if specified, to deck with Factory Mutual approved fasteners and plates in accordance with requirements of Factory Mutual.
 1. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 2. Lay insulation boards such that edges (sides or ends) of board running parallel to the direction of the metal deck flutes are fully supported on the top flange as close as practical to the center of the flange with a minimum bearing of 1 inch. Trim board edges if they veer off the flange center.
 3. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 3 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 4. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 5. Install fasteners using drill with torque clutch; other types of drills will not be permitted.
 6. In no case shall the number of fasteners be less than indicated in approved submittals.
- B. Lay insulation boards to moderate contact without forcing joints. Cut insulation to fit neatly around protrusions through roof. At parapet walls, cope insulation around protrusions and embed plates; butt tight to wall, sealing conditioned building.
 1. Fill gaps over 1/4 inch wide with Foam Filler Insulation. After foam sets and before installation of membrane, trim foam flush with insulation surface.
- C. Tapered Insulation: Install tapered insulation in accordance with manufacturer's instructions and the following:
 1. Mechanical Unit Crickets and Saddles: Install field-fabricated tapered isocyanurate foam insulation to achieve slope as shown on Drawings but not less than 1/4 inch per foot finished slope.

2. Roof Counterslope: Where tapered insulation is indicated to counter roof slope, install field-fabricated tapered isocyanurate foam insulation to achieve 1/4 inch per foot min. finished slope.
 3. Edge Taper Insulation: Adjacent to gutter assembly, slope field-fabricated tapered isocyanurate foam insulation at minimum rate of 1/2 inch per foot. Provide insulation having a starting thickness of one inch, tapering insulation up to match nominal roof insulation thickness.
- D. Apply no more insulation than can be sealed with membrane in same day.
- E. Adhere a single layer of insulation to manufactured metal curbs with bonding cement.

3.5 ROOF MEMBRANE INSTALLATION

- A. Mechanically Fastened Membrane:
1. Run membrane perpendicular to steel deck flutes. Unroll membrane over prepared substrate, lapping adjoining sheets as recommended by manufacturer.
 2. Mechanically fasten membrane using manufacturer's fastening system. Install fasteners in accordance with submitted engineered layout pattern to resist specified wind uplift.
 3. Install fasteners using drill depth sensing or torque limiting screw guns to limit under / over drive of fasteners. Drill motors and other non-limiting drivers shall not be used.
 4. Seam Sealing: Heat-weld seams according to the system manufacturer's recommendations, and with a minimum weld width of 1-1/2 inches.
- B. Cold Weather Application Procedures: When air temperature is expected to fall below 40 degrees F, follow Cold Weather Application Procedures as follows:
1. Store materials in heated storage units prior to installation. Rotate adhesive, cement, and sealant containers to maintain their temperature above 40 degrees F.
 2. Allow membrane to relax until no wrinkles are visible.
 3. Allow adequate time for solvents in cements to flash off. Check dryness of applied cements before sealing joints.
 4. Verify that frost, dew, and other forms of moisture have evaporated prior to covering insulation with membrane to prevent entrapment of moisture within finished roof system.

3.6 WATER CUTOFFS AND WEATHER PROTECTION

- A. Install water cut-offs at end of day's operation to seal insulation and edge of roof membrane from moisture entry. If inclement weather appears imminent during roofing application, cease operations and protect deck, insulation, flashings, penetrations and membrane from moisture infiltration with water cutoffs. Insulation and roofing materials not so protected prior to inclement weather will be considered damaged and will be cause for rejection.
- B. Remove water cut-offs and other temporary weather protections prior to continuing roofing work. Remove materials that have been subject to moisture damage and return deck to a clean, dry condition before proceeding with roofing operations. Remove damaged materials from job site.
- C. The water cut-offs and weather protection shall not be considered a part of the final roof system specified.

3.7 FLASHING MEMBRANE AND ACCESSORIES INSTALLATION

- A. Flashing Membrane:
1. Apply flexible flashings to seal membrane to vertical elements using manufacturer's standard peel and stick flashing.
 2. Heat weld flashing in the field of the roof, along gutters, and in scuppers.
 3. Reinforced Flashing Membrane: Where conditions permit, flash penetrations and walls with reinforced flashing membrane.
 4. Uncured Flashing: Limit use of uncured flashing to overlay vertical seams as required at angle changes, to flash inside and outside corners, scuppers, and other penetrations or unusually shaped walls as approved by the manufacturer.

- B. Roof Penetrations:
 1. Molded Pipe Flashing: Install where shown and elsewhere whenever configuration of penetration will permit.
 2. Install flashings per manufacturer's application instructions.
 3. Comply with manufacturers recommendations for flashing for pipe penetrations larger than 6 inches.
- C. Seal flashings and flanges of items penetrating membrane.
- D. Fasten termination bars at 12 inches on center or less to maintain constant compression.
- E. Isolation Pads: Install isolation pads at pipe supports.
- F. Walkway Pads: Install walkway pads as shown on Drawings. Maximum pad section length shall be 10 ft with three inch spacing between pad sections, unless indicated otherwise on Drawings. Adhere pads to roofing system to prevent displacement in maximum anticipated design wind velocity and to allow drainage of moisture from beneath pads. Install pads to allow roof surface drainage without ponding water. Install pads after adjacent equipment installation.

3.8 WATERPROOFING MEMBRANE INSTALLATION

- A. Waterproofing Membrane: Install waterproofing membrane to be fully adhered to parapet using bonding adhesive as recommended by membrane manufacturer. Run membrane waterproofing over top of parapet and turn down front side of parapet 3 inches.
 1. Provide continuous weather tight seal from 3 inches below parapet cap, over parapet, down interior face, and onto roof surface.
 2. Conceal adhesive on exterior face of parapet with waterproofing.
 3. When EPDM waterproofing membrane is used, lap waterproofing membrane over roof membrane and secure with splice tape and pressure sensitive flashing as indicated on Drawings and as recommended by roofing system manufacturer.

3.9 WATERPROOFING FLASHING INSTALLATION

- A. Waterproofing Flashing: Apply waterproofing flashing to seal membrane to vertical elements using manufacturer's peel and stick flashing.
- B. Comply with the following requirements when using TPO waterproofing flashing:
 1. Reinforced Waterproofing Flashing: Where conditions permit, flash walls with reinforced waterproofing flashing or as required by the manufacturer.
 2. Uncured Flashing: Limit use of uncured flashing to overlay vertical seams as required at angle changes, to flash inside and outside corners, scuppers, and other penetrations or unusually shaped walls where use of reinforced waterproofing flashing is not practical or as required by the manufacturer.

3.10 INTERFACE WITH OTHER WORK

- A. Coordinate Work with installation of associated roof edge fascia system specified under other sections as the Work of this Section proceeds.
- B. Complete installation of base flashing at roof curbs prior to setting roof top equipment.

3.11 FIELD QUALITY CONTROL

- A. Core samples shall be taken when required to evaluate problems observed during quality control inspections of roofing membrane as follows:
 1. Cut samples shall be taken where and when as recommended by the RECC or the Manufacturer's Technical Representative when determined necessary for quality control validation or to determine the extent of deficiencies discovered during construction or during final roofing inspection. Except where cut samples are taken to investigate deficiencies, no more than two cut samples per 100 squares or one cut sample from each

- day's work shall be required
2. Submit core samples to the RECC or the Manufacturer's Technical Representative for examination depending on the source of the recommendation. Deficiencies shall be reported to the Architect by the RECC or the Manufacturer's Technical Representative.
- B. The Contractor shall be responsible for sampling and testing specified herein.
- C. Manufacturer Services:
1. Engage Manufacturer's Technical Representative to provide site inspection and reports.
 2. Inspection by the Manufacturer's Technical Representative shall include the following:
 - a. Periodic site visits during the roof installation as many times as necessary to ensure adequate observations and proper installation but at least at the following milestones.
 - (1) After 30% but prior to 50% of roof installation.
 - (2) At 100% completion of roof installation.
 - (3) Final Inspection: At possession.
 - b. Site inspection reports. Provide copies of Manufacturer's Technical Representative's periodic inspection reports as specified in Part 1 above.
 - c. Field testing recommendations.
 - d. Oversight of remedial repairs in the field.
 - e. Administration and maintenance of the online Owner's Observation Log with respect to roofing defects and repairs.
 - f. Verification of completion of magnetic sweeping prior to Project completion.
 - g. Conducting comprehensive roof inspection upon completion of roofing together with all parties to be signatories to Roof Inspection Checklist included at the end of this section.
 - h. Identification of defects on the Owner's Observation Log. (www.bldgportal.com, enter username and password, select Observation Log)
 - i. Conducting a final audit 10 months after acceptance with Owner's representative as scheduled by Owner.
- D. Owner's Roofing and Exterior Coatings Consultant (RECC) Services: Within two weeks prior to Project completion, the RECC will perform a roof construction inspection at no cost to the Contractor as specified in Appendix B.
- E. Comprehensive Final Inspection and Roof Inspection: Upon completion of roofing work at the time of three to five weeks prior to Project completion, a Comprehensive Final Roof Inspection shall be conducted by the Manufacturer's Technical Representative according to the Comprehensive Final Roof Inspection Instructions and Checklist included herein at the end of this Section, and as follows:
- a. Attendees of the final roof inspection shall include all signors to the checklist.
 - b. Checklist shall be completed by the Manufacturer's Representative and provided to all signors.
 - c. Checklist shall be used by the Contractor during construction as a tool to measure quality of roofing work as the work progresses.

3.12 CLEANING

- A. Replace defaced or disfigured finishes caused by Work of this Section.
- B. One week prior to Project completion, sweep entire roof surface with a magnetic sweeper to remove nails, screws and other metal items which may cause subsequent damage to the roof.

3.13 PROTECTION

- A. Where construction traffic must continue over finished roof installation, protect roof surfaces as recommended by roofing system manufacturer to protect manufacturer's warranty.

3.14 MAINTENANCE AND REPAIR DURING CONSTRUCTION

- A. Maintain roofing system and related work from time of roofing completion until Contract completion. Repair material or installation defects or damage resulting from any subsequent work on the roof or from any weather-related damage. Maintain roof system in watertight condition including repair of conditions that show signs of inferior workmanship that may result in potential leaks. Repair leaks occurring prior to Contract completion in accordance with good roofing practice and the requirements specified herein. Remove and replace wet insulation caused by water leaks and repair the roofing system.

3.15 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 07500).

END OF SECTION

ROOFING SYSTEM WARRANTY

Owner: _____

Address of Owner: _____

Type and Name of Building: _____

Location: _____

Roofing System Specification Number: _____ Area of Roof System: _____

Date of Project Completion: _____ Date Warranty Expires: _____

Manufacturer's 24 hour Emergency Telephone: (____) _____ (no answering machines or message Center)

Contact Name: _____

Contractor's Telephone: (____) _____ (no answering machines or message center)

Contact Name: _____

Upon completion of and after inspection by the Manufacturer of such Work, Manufacturer agrees to warrantee the aforesaid Roofing System for a limited period and subject to the conditions herein set forth:

Manufacturer Warrantees, subject to the conditions herein set forth, that during a period of 15 years from the date of Project completion, it will, at its own cost and expense, make or cause to be made such repairs to said Roofing System resulting solely from faults or defects in materials and/or workmanship applied by or through the Roofing System Contractor as may be necessary to maintain said Roofing system in watertight condition. Owner's remedies and manufacturer's liability shall include cost of labor and materials for loss of weather tightness without financial limit. In accordance with good roofing practice, the Manufacturer shall remove and replace all wet insulation (as defined in specifications) caused by water leaks covered under this Warranty (i.e. leaks resulting from circumstances other than those listed in the exclusions) and repair the Roofing System at no cost to the Owner. Should the investigation reveal that the leak is the result of something other than a defect in materials and/or workmanship applied by or through the Roofing System Contractor, the reasonable investigative work and reasonable repair costs shall be paid by the Owner. Failure by the Owner to pay these costs shall render this warranty null and void.

Warranty shall include materials and workmanship from the following items:

1. Membranes (including parapet waterproofing).
2. Membrane flashings including attachment to sheet metal flashings and trim.
3. Fasteners, cements, and adhesives.

This warranty is made subject to the following conditions:

1. The Owner shall notify Manufacturer within 24 hours of notice by the Owner's Roof Maintenance Department of leaks. The Manufacturer will respond with service within 24 hours of notice from owner (if not possible, than no later than 48 hours, however Owner retains the right to make repairs at Warrantor's expense to mitigate damages).
2. Specifically excluded from this Warranty is any and all damage to said roof system, the building, or contents caused by natural disasters, including, but not limited to: earthquake, hail, lightning, hurricane, tornado, strong gale wind force (72 MPH or greater), or structural failure of the building or of the roof deck (as defined by a licensed Structural Engineer and except that caused by the Manufacturer), fire, and acts of war. If the roof system is damaged by reason of any of the foregoing, this warranty shall become null and void (AFFECTED AREAS ONLY) for the balance of the warranty period unless such damage is repaired at the expense of the owner.
3. Manufacturer is not liable for consequential damages to the building or contents resulting from any defects in said roof system, including, but without limitation, any interruption of business experienced by Owner or occupants of the building.
4. All additions and/or alterations to the roof system shall be installed in accordance with the manufacturer's written recommendations and the manufacturer should provide prior to acceptance to said additions or alterations. Should

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unauthorized additions/alterations be discovered by the Owner's Roof Maintenance Department, the manufacturer will be notified in writing within fourteen days of such discovery. Provide at manufacturer's discretion an inspection of the unauthorized additions/alterations and notify the Owner in writing of any remedy required by the manufacturer within fourteen days. This Installation/Inspection by the Manufacturer is to be done at a cost to Owner of not more than \$500.00 to cover travel and time for the inspector. Provide inspection of said roof during business hours. Failure to notify the Owner of any required remedy shall deem the addition/alteration acceptable to the Manufacturer and the warranty will remain in effect.

5. The area of additions and/or alterations shall be the only area of the roof system where warranty is suspended. All other roof system areas will have continual coverage under the roof warranty.
6. This Warranty is transferable within the 15-year warranty period, subject to Manufacturer's inspection, written approval and transfer fee payment.
7. During the term of this warranty, the manufacturer, its agents and employees, shall have free and unlimited access to the roof during the hours of store operation.
8. The terms and conditions of this warranty are controlling. Any other warranty conditions attached or referenced that are in conflict with this warranty are ineffective and invalid.
9. This limited warranty shall be governed and construed in accordance with the laws of the State of Arkansas without regard to conflict of laws.
10. The Manufacturer does not warrant products incorporated or utilized in this installation that it has not furnished. The Manufacturer specifically disclaims liability under any theory of law arising out of the installation or performance of, or damages sustained by or caused by, products not furnished by the Manufacturer.

IN WITNESS WHEREOF, this instrument has been duly executed this ____ day of _____, _____.

By _____

END OF WARRANTY

COMPREHENSIVE FINAL ROOF INSPECTION

INSTRUCTIONS

TOOLS AND SUPPLIES: Provide the following during inspections:

- Copy of roof plan and copy and specifications.
- Tape measure, metal thickness gauge, paint for marking defects on roof, roof coring tools and repair materials, and seam probe (to be supplied by Roofing Contractor).

INSPECTION PROCEDURE

- The Manufacturer's Technical Representative shall arrange and conduct inspection and complete checklist and identify defects and enter into Owner's Observation Log.
- All undersigned parties shall accompany inspection.
- Inspect underside of decking from inside of building for proper insulation fastener spacing and sheet fastener spacing.
- Roof Inspection shall start at the parapet wall on the GM side of the building, at the back corner.
- Proceed around perimeter, (including Auto Center, Garden Center, etc).
- Continue across front wall and down sidewall at GR.
- Inspect metal flashings, roof edge fascia system, perimeter attachments, perimeter membrane sheet layout, parapet waterproofing membrane, and accessories.
- Inspect condition of paint on exterior walls. Inspect CMU for proper paint coverage.
- Inspect painted metals for proper coverage.
- Inspect back wall gutter or internal drainage system.
- Inspect field of roof system, beginning approx. 10 feet from back wall, walking side to side of building.
- Inspect roof area no more than 10 feet on each side of walking paths, from back, to front of building.
- Inspect checklist items at field seams, flashings, RTUs, mechanical equipment, skylights, refrigeration units, gas lines, expansion joints, crickets, walkpads, and other roof accessories.
- Mark defects on roof by paint markings and identify each defect using corresponding defect number.
- After roof inspection is complete, email signed inspection form to Owner's Construction Manager within 24 hours.

COMPLETION OF CHECKLIST AND DEFECTS FORM

- Answer each checklist item Yes or No.
- Mark "N/A" on checklist items which do not apply.
- Identify defects on the Owner's Observation Log. (www.bldgportal.com, enter username and password, select Observation Log)
- Number each defect as follows:
 - Identification Symbol-Checklist Item No.-Defect No. (E.g. MF-1-3)
 - Identification symbol and checklist item number shall correspond to the Roof Inspection Checklist. The defect number shall be numbered in sequence for each checklist item.
- Complete applicable information in the Observation Log including the resolution of each item.

ROOF INSPECTION CHECKLIST

(GI) GENERAL:

- 1. Is specified roof system installed? YES__ NO__ N/A__
2. Is construction materials, trash, and other debris removed from the roof? YES__ NO__ N/A__
3. Are all punch list items addressed and signed off? YES__ NO__ N/A__
4. Is there any visible physical damage to roof? YES__ NO__ N/A__
5. Are RTU's numbered so they can be seen from the roof hatch? YES__ NO__ N/A__
6. Is roof hatch painted? YES__ NO__ N/A__
7. Is there roofing mastic or other foreign substance on roof membrane? YES__ NO__ N/A__

(MF) MECHANICAL FASTENERS: (Check from inside building)

- 1. Is insulation attachment pattern installed per manufacturers required spacing and pattern? YES__ NO__ N/A__
2. Is membrane sheet attachment in the seams at minimum 12" inches o.c. or per manufacturers required spacing? YES__ NO__ N/A__
3. Are all seams mechanically attached? YES__ NO__ N/A__

(RE) ROOF EDGE FASCIA SYSTEM

- 1. At splice locations do the covers lap over one another by approximately 1-inch? YES__ NO__ N/A__
2. Are anchor bars installed with 1/2-inch spacing between bars? YES__ NO__ N/A__
3. Are anchor bar splice plates installed? YES__ NO__ N/A__
4. Does the leg of each miter measure minimum 15-inches from the corner to the splice? YES__ NO__ N/A__
5. Is the back leg of the cover embossed with either the ANSI/SPRI label or manufacturers name? YES__ NO__ N/A__
6. Has protective film been removed from the cover? YES__ NO__ N/A__
7. Has any damage been observed on the cover due to the installation? YES__ NO__ N/A__

(PW) PARAPET WALL MEMBRANE

- 1. Is membrane fully adhered in all areas to the parapet walls? YES__ NO__ N/A__
2. Are there any voids, wrinkles, or disbonded areas? YES__ NO__ N/A__
3. Is termination bar installed at the base flashing? YES__ NO__ N/A__
4. Is base flashing run onto the roof membrane and seam sealant used? YES__ NO__ N/A__
5. Are corner flashings installed? YES__ NO__ N/A__
6. Are there any open seams? YES__ NO__ N/A__
7. Is membrane terminated and sealed at parapet end wall conditions? YES__ NO__ N/A__
8. Are all parapet end walls fully painted or flashed? YES__ NO__ N/A__

(PA) PERIMETER MEMBRANE SHEETS ATTACHMENT

- 1. Are the required number perimeter sheets per system specification installed? YES__ NO__ N/A__
2. Are fasteners spaced per the manufacturers requirements? YES__ NO__ N/A__
3. Are T-Lap patches installed at all T-joints? YES__ NO__ N/A__
4. Are seams properly sealed? YES__ NO__ N/A__

(EW) EXTERIOR WALL PAINT (Inspect every 25' minimum.)

- 1. Is wall painted/sealed? YES__ NO__ N/A__
2. Are there visible voids in the paint? YES__ NO__ N/A__
3. Are there cracks in blocks or open mortar joints? YES__ NO__ N/A__
4. Are walls painted behind downspouts? YES__ NO__ N/A__

DRAINAGE SYSTEM (Check all that apply)

- [] Gutters and downspouts
[] Interior drains [] Overflow drains [] Overflow scuppers
[] Scuppers with leaders & downspouts [] Overflow scuppers

Specified gauge (Check all areas with gauge)

- Main roof area _____ gauge
• Auto Center _____ gauge
• Garden Center _____ gauge
• Receiving _____ gauge

- Other _____ gauge _____

(GD) GUTTERS AND DOWNSPOUTS

- | | | | |
|--|---------|--------|---------|
| 1. Is specified type of metal installed? | YES ___ | NO ___ | N/A ___ |
| 2. Is gutter sized as indicated on the drawings? | YES ___ | NO ___ | N/A ___ |
| 3. Is gutter holding water? | YES ___ | NO ___ | N/A ___ |
| 4. Is gutter painted inside? | YES ___ | NO ___ | N/A ___ |
| 5. Are gutter straps installed every 36" o.c.? | YES ___ | NO ___ | N/A ___ |
| 6. Are gutter expansion joints installed every 40' maximum? | YES ___ | NO ___ | N/A ___ |
| 7. Are gutter outlets soldered to the gutter? | YES ___ | NO ___ | N/A ___ |
| 9. Are gutter brackets installed every 36" o.c.? (Inspect from the ground level) | YES ___ | NO ___ | N/A ___ |
| 10. Are downspouts the specified size and configuration? | YES ___ | NO ___ | N/A ___ |
| 11. Are downspout straps installed at top, center, and bottom? | YES ___ | NO ___ | N/A ___ |
| 12. Are downspouts spaced as called out in the documents? | YES ___ | NO ___ | N/A ___ |
| 13. Are splash blocks installed? | YES ___ | NO ___ | N/A ___ |
| 14. Are downspouts properly tied to the storm sewer? | YES ___ | NO ___ | N/A ___ |
| 15. Are joints in gutter leaking? | YES ___ | NO ___ | N/A ___ |
| 16. Are outlets in gutter leaking? | YES ___ | NO ___ | N/A ___ |

(RE) ROOF EDGE

- | | | | |
|--|---------|--------|---------|
| 1. Is gravel guard properly installed? | YES ___ | NO ___ | N/A ___ |
| 2. Is gravel guard properly stripped into roof system? | YES ___ | NO ___ | N/A ___ |
| 3. Is gravel guard prefinished or painted? | YES ___ | NO ___ | N/A ___ |
| 4. Is gravel guard nailed at 3" o.c. staggered? | YES ___ | NO ___ | N/A ___ |
| 6. Is roof edge ponding water? | YES ___ | NO ___ | N/A ___ |

(DR) INTERIOR DRAINS

- | | | | |
|---|---------|--------|---------|
| 1. Are roof drains the specified diameter? | YES ___ | NO ___ | N/A ___ |
| 2. Are overflow drains the specified diameter? | YES ___ | NO ___ | N/A ___ |
| 3. Does the roof drain outlet diameter match the diameter of the leader pipe? | YES ___ | NO ___ | N/A ___ |
| 4. Is roof membrane properly trimmed inside the roof drain? | YES ___ | NO ___ | N/A ___ |
| 5. Is roof drain free of debris and draining properly? | YES ___ | NO ___ | N/A ___ |
| 6. Is insulation tapered around the roof drains? | YES ___ | NO ___ | N/A ___ |
| 7. Are roof drains checked for leaks inside the store? | YES ___ | NO ___ | N/A ___ |
| 9. Are roof drain strainers in place? | YES ___ | NO ___ | N/A ___ |
| 10. Does ponding exist? | YES ___ | NO ___ | N/A ___ |

(SC) SCUPPERS

- | | | | |
|---|---------|--------|---------|
| 1. Are scuppers the specified height and width? | YES ___ | NO ___ | N/A ___ |
| 2. Are scuppers located directly in line with the primary and over flow drains? | YES ___ | NO ___ | N/A ___ |
| 3. Are scuppers flush with the roof? | YES ___ | NO ___ | N/A ___ |
| 4. Does ponding exist? | YES ___ | NO ___ | N/A ___ |
| 5. Is scupper box installed and sealed to the wall? | YES ___ | NO ___ | N/A ___ |
| 6. Are scuppers properly flashed to roof system? | YES ___ | NO ___ | N/A ___ |

(JC) JIB CRANE

- | | | | |
|--|---------|--------|---------|
| 1. Is jib crane located with unobstructed clear space below? | YES ___ | NO ___ | N/A ___ |
| 2. Is jib crane usable in a safe manner? | YES ___ | NO ___ | N/A ___ |
| 3. Is safety chain installed? | YES ___ | NO ___ | N/A ___ |
| 4. Is ladder safety chain installed? | YES ___ | NO ___ | N/A ___ |
| 5. Is GFI outlet installed within 6' reach of the jib hoist arm? | YES ___ | NO ___ | N/A ___ |
| 6. Are walkway protection pads installed? | YES ___ | NO ___ | N/A ___ |
| 7. Is parapet door in place (on raised parapet projects)? | YES ___ | NO ___ | N/A ___ |

(RM) ROOF FIELD MEMBRANE:

(Seams should be checked in random areas for proper seals and voids. No wrinkles in seams will be acceptable.)

- | | | | |
|---------------------------------------|---------|--------|---------|
| 1. Is maximum width field sheet used? | YES ___ | NO ___ | N/A ___ |
|---------------------------------------|---------|--------|---------|

- | | | | |
|--|---------|--------|---------|
| 2. Are all seams properly lapped and sealed? | YES ___ | NO ___ | N/A ___ |
| 3. Are T-lap patches in place at all T-Laps? | YES ___ | NO ___ | N/A ___ |
| 4. Are all edges of cut sheet sealed? | YES ___ | NO ___ | N/A ___ |
| 5. Are there wrinkles in any laps? | YES ___ | NO ___ | N/A ___ |
| 6. Does any ponding exist in roof area? | YES ___ | NO ___ | N/A ___ |
| 7. Is membrane shingled properly with the slope of the roof? | YES ___ | NO ___ | N/A ___ |

(RI) ROOF INSULATION

- | | | | |
|---|---------|--------|---------|
| 1. Is insulation the specified thickness? (Verify by roof cores if necessary) | YES ___ | NO ___ | N/A ___ |
| 2. Are there visible gaps in the insulation boards? | YES ___ | NO ___ | N/A ___ |
| 3. Is there ponding along horizontal insulation joints? | YES ___ | NO ___ | N/A ___ |
| 4. Are there voids or missing insulation? | YES ___ | NO ___ | N/A ___ |

(RTU) ROOF TOP UNITS & REFRIGERATION UNITS FLASHINGS:

- | | | | |
|---|---------|--------|---------|
| 1. Are base flashings fully adhered to curb? | YES ___ | NO ___ | N/A ___ |
| 2. Are corner flashings on curbs installed? | YES ___ | NO ___ | N/A ___ |
| 3. Are seams to roof membrane sealed with no voids or wrinkles? | YES ___ | NO ___ | N/A ___ |
| 4. Are crickets installed to divert water around unit? | YES ___ | NO ___ | N/A ___ |
| 5. Are counterflashings installed and properly attached? | YES ___ | NO ___ | N/A ___ |
| 6. Are walkpads installed as per the documents? | YES ___ | NO ___ | N/A ___ |
| 7. Are condensation P-traps installed on all units? | YES ___ | NO ___ | N/A ___ |

(GL) GAS LINES:

- | | | | |
|---|---------|--------|---------|
| 1. Are gas lines painted? | YES ___ | NO ___ | N/A ___ |
| 2. Is blocking spaced under line at 8' o.c max.? | YES ___ | NO ___ | N/A ___ |
| 3. Is blocking located within 2' of RTU? | YES ___ | NO ___ | N/A ___ |
| 4. Is blocking located within 1'-6" of each corner? | YES ___ | NO ___ | N/A ___ |
| 5. Are protection pads under each block? | YES ___ | NO ___ | N/A ___ |
| 6. Are protection pads the correct size and fully adhered? | YES ___ | NO ___ | N/A ___ |
| 7. Are pipe clamps correct sizes and installed per the documents? | YES ___ | NO ___ | N/A ___ |
| 8. Are gas pipe dirt legs touching roof? | YES ___ | NO ___ | N/A ___ |

(EJ) ROOF EXPANSION JOINTS

- | | | | |
|--|---------|--------|---------|
| 1. Is expansion joint installed? | YES ___ | NO ___ | N/A ___ |
| 2. Is joint properly terminated at the parapet at the front? | YES ___ | NO ___ | N/A ___ |
| 3. Is joint properly terminated at the rear? | YES ___ | NO ___ | N/A ___ |
| 4. Is joint properly flashed to roof system? | YES ___ | NO ___ | N/A ___ |
| 5. Are there any open seams? | YES ___ | NO ___ | N/A ___ |

(MI) MISCELLANEOUS ITEMS

- | | | | |
|---|---------|--------|---------|
| 1. Are soil stacks properly flashed and clamps installed? | YES ___ | NO ___ | N/A ___ |
| 2. Are roof jacks properly flashed and collars sealed? | YES ___ | NO ___ | N/A ___ |
| 3. Are protection pads under support? | YES ___ | NO ___ | N/A ___ |

ATTENDED BY:

GENERAL CONTRACTOR

(Printed name and title)

ROOFING CONTRACTOR

(Printed name and title)

MANUFACTURERS REP.

(Printed name and title)

OWNER'S CONST MGR.

(Printed name and title)

STORE MANAGER

(Printed name and title)

MANUFACTURER'S ROOFING PRE-INSTALLATION NOTICE

Report Date	
Store No., City, and State (Job Name)	
Store Address	
Square Footage	

The following report has been prepared by:

Manufacturer	
Address	
Manufacturer Representative Direct Contact	
Manufacturer Warranty No.	

The following report has been prepared for:

General Contractor	
Address	
General Contractor Direct Contact	

Qualification and Experience of Roofing Contractor:

Roofing Contractor Company Name	
Address	
Roofing Contractor Direct Contact	
Roofing Contractor Owner Name	

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SECTION 07611 (07 4116) - SHEET METAL SOFFIT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preformed metal soffit panels.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 05400 - Cold Formed Metal Framing: Steel framing supporting metal soffit.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 2605 - Specifications, Performance Requirements And Test Procedures For Superior Performing Organic Coatings And Aluminum Extrusions And Panels.
- C. ASTM International (ASTM):
 - 1. ASTM A 755/A - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 2. ASTM A 792/A - Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect products.
- B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- C. Deliver panels to site in dry and undamaged condition. Unload and handle in accordance with manufacturer's published instructions.
- D. Store panels off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation.

PART 2 - PRODUCTS

2.1 METAL SOFFIT

- A. Metallic-Coated Steel Sheet:
 - 1. Steel Sheet with Organic Coating Finish: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 - 2. Steel Sheet with Aluminum or Galvalume Finish: Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
- B. Manufacturer: Subject to compliance with requirements, provide product equivalent to those specified by any one of the following manufacturers:
 - 1. AEP-SPAN; Dallas, TX; (800) 527-2503.
 - 2. Berridge Manufacturing Co., Houston, TX; (800) 231-8127.
 - 3. Fabral Metal Roof and Wall Systems, Lancaster, PA (800) 884-4484.
 - 4. MBCI; Houston, TX; (800) 861-6224

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5. McElroy Metal, Bossier City, LA, (800) 950-6531.
6. PAC-CLAD, Petersen Aluminum Corporation, Elk Grove Village, IL (800) 722--2523.

C. Description:

1. Exterior Soffit (Prefinished Metal Soffit Panels): L-Panel by Berridge, 24 gage steel grooved panels, concealed fasteners. Panel profile shall be approximately 12" panel width, 1" panel depth, 3" groove spacing or similar panel profile by any named manufacturer.

2.2 ACCESSORIES

- A. Provide manufacturer's standard accessories and other special items required and essential to completeness of soffit installation. Sight-exposed accessories shall match finish of metal soffit system.
1. Trim Items: Of same material and finish as soffit sheets.
 2. Fasteners: As recommended by soffit system manufacturer for intended purpose.
 3. Sealants: Color coordinated primerless silicone or high grade non-drying butyl, recommended by panel manufacturer.

2.3 FABRICATION

- A. Factory fabricate and finish panels and accessories ready for field assembly.
- B. Form sections true to shape, accurate in size, square, and free from distortion.
- C. Fabricate panels in one piece. In areas where one piece is impractical, fabricate panels in minimum number possible of equal lengths. Fabricate accessories in longest practicable lengths.

2.4 FINISHES

- A. Exterior Soffit: Factory finish surfaces with high performance pigmented organic coating. Prepare, pretreat, and apply coating to exposed metal surfaces in conformance with coating and resin manufacturer's instructions providing finish free of scratches and other blemishes.
1. Finish: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing minimum of 70 percent Penwalt Kynar 500 resin by weight with total minimum dry film thickness of 1.0 mil and 30 percent reflective gloss when tested in accordance with ASTM D 523 and complying with physical properties and coating performance requirements of AAMA 2605, except Humidity Resistance and Salt Spray Resistance shall be 2000 hours
 2. Color as indicated on Drawings:

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine building structure and adjacent areas where panels will be installed. Do not proceed with Work until unsatisfactory conditions have been corrected.
1. Examine soffit structure to verify that structure is ready for soffit panel installation.
 2. Verify field dimensions to determine compliance with panel manufacturer's tolerances.
- B. Beginning of installation indicates acceptance of existing conditions.

3.2 INSTALLATION

- A. Install soffit panels in accordance with manufacturer's published instructions.
- B. Secure panel in place with concealed fasteners.
- C. Interlock panels and secure in place to prevent warping and wracking.

D. Back paint surfaces in contact with dissimilar materials.

3.3 FIELD QUALITY CONTROL

A. Inspect soffit panel installation, alignment, attachments, trim, and accessories.

3.4 CLEANING

A. Wipe clean each soffit panel after erection.

B. Replace damaged panels and other components of Work which cannot be repaired by finish touch-up or similar minor repairs.

C. Remove from finished surface, filing caused by drilling and cutting of panels.

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END OF SECTION

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SECTION 07620 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fascia and roof edge trim.
 - 2. Counterflashing over base flashing.
 - 3. Metal parapet cap.
 - 4. Refrigeration line hood.
 - 5. Multiple vent hood.

- B. Related Sections:
 - 1. Section 06100 - Rough Carpentry: Wood blocking and nailers.
 - 2. Section 07500 - Membrane Roofing: Roof penetration flashing and seals.
 - 3. Section 07900 - Joint Sealers.
 - 4. Section 09900 - Paints and Coatings.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

- C. ASTM International (ASTM):
 - 1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 755/A - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 3. ASTM A 792/A - Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 - 4. ASTM B 749 -Lead and Lead Alloy Strip, Sheet, and Plate Products
 - 5. ASTM D 226 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 6. ASTM D 523 - Standard Test Method for Specular Gloss
 - 7. ASTM D 4586 - Specification for Asphalt Roof Cement, Asbestos Free.

- D. National Roofing Contractors Association (NRCA):
 - 1. NRCA - Low Slope Roofing Manual.

- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. SMACNA - Architectural Sheet Metal Manual, Fifth Edition, 1993.

- F. Steel Structures Painting Council (SSPC):
 - 1. SSPC-Paint 12 - Cold-Applied Asphalt Mastic (Extra Thick Film).
 - 2. SSPC-Paint 20 Type II - Zinc Rich Primers - Organic.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA "Architectural Sheet Metal Manual" and NRCA "Low Slope Roofing Manual" standard details and requirements.

- B. Supplier Certification: Provide certification from galvanized sheet steel supplier stating that materials conform to ASTM A 653, G90 hot-dipped galvanized steel.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.
- B. Prevent contact with materials during storage that may cause discoloration, staining, or damage.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- A. Galvanized Steel: ASTM A 653 Commercial Quality and Lock-Forming Quality, G90 coating designation hot-dip galvanized, mill phosphatized for painting where exposed to view from ground level. Sheet metal gages shall be as shown or as follows where not shown:
 - 1. Flashing and Counter Flashing: 24 gage.
 - 2. Fascia and Edge Trim: 24 gauge.
 - 3. Curb-Mounted Refrigeration Line Hood: 22 gage.
 - 4. Multiple Vent Hood: 22 gage.

2.2 ACCESSORIES

- A. Fasteners: Galvanized steel finish exposed fasteners to match flashing metal. Furnish exposed fasteners with soft EPDM washers as manufactured by the following:
 - 1. Kwik-Pro Screws, by Hilti.
 - 2. Trugrip GT, by ITW Buildex.
- B. Sealant: Specified in Section 07900.
- C. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15 mil dry film thickness per coat.
- D. Draw Band: Stainless steel.
- E. Underlayment:
 - 1. Asphalt Saturated Felt: ASTM D 266; No. 30 pound asphalt saturated organic roofing felt, nonperforated.
- F. Zinc-Rich Primer: SSPC-Paint 20 Type II.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, interlockable with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Fabricate corners to form one piece with minimum 18 inches long legs; rivet for rigidity.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 4 inches over roofing. Return and brake edges.
- H. Fabricate exposed sheet metal components with provisions for thermal expansion.

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2.4 FINISH

- A. Paint metal surfaces exposed to view from ground level in accordance with Section 09900, and as indicated on Drawings, unless otherwise shown to be prefinished.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set.
- B. Verify roofing membrane termination and base flashings are in place, sealed, and secure.
- C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work.
- B. Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

- A. Install sheet metal flashing and trim in accordance with applicable details of SMACNA "Architectural Sheet Metal Manual" and NRCA "Low Slope Roofing Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Bed flanges of metal flashings in plastic cement or sealing mastic where required for waterproof performance.
- C. Apply bituminous coating on surfaces in contact with dissimilar materials including the following:
 - 1. Dissimilar metals as defined in SMACNA Appendix A-3.
 - 2. Preservative treated wood.
- D. Roof Edge Trim:
 - 1. Install sheet metal edge trim in accordance with SMACNA Figure 2-1, profile as indicated on Drawings. Nail edge trim flange at 3 inches on center, in staggered pattern.
 - 2. Thermal Expansion Joints: Install roof edge trim in 10 foot lengths with a 1/4 inch gap joint with a 6 inch cover plate in accordance with SMACNA Figure 2-5A. Set the cover plate in sealant, nail through opening in edge trim, and loose lock to the drip edge.
 - 3. Corner Joints: Notch and lap. Set laps in sealant and rivet for rigidity. Space rivets at 1 inch on center.
- E. Parapet Cap Flashing – Option A:
 - 1. Install prefinished sheet metal fascia with cleat in accordance with SMACNA Figure 2-6, profiles and as indicated on Drawings.
 - a. Set cleat in full bed of sealant, overlaying and concealing continuous parapet waterproofing membrane.
 - b. Secure cleat to nailer at 6 inches on center.
 - c. Secure fascia to wood nailer with fasteners at 3" o.c. staggered per basic flange nailing pattern.
 - 2. Thermal Expansion Joints: Install parapet fascia in min 10 foot lengths with 4 inch lap joint in accordance with SMACNA Figure 2-5B. Set lap in sealant.
- F. Parapet Cap Flashing – Option B:
 - 1. Install prefinished sheet metal coping with continuous cleat in accordance with SMACNA requirements, profiles as indicated.
 - a. Set cleat in full bed of sealant, overlaying and concealing continuous parapet waterproofing membrane.

- b. Secure cleat at 6 inches on center to nailer.
 2. Install coping in accordance with SMACNA Figure 3-1 over shaped fiber board; secure roof side edge using washered screws in staggered pattern through slotted or oversized holes located at maximum 12" on-center.
 3. Provide coping in minimum 10 to maximum 25 foot lengths.
 4. Provide thermal expansion joints using joints in accordance with SMACNA Figure 3-3, Covered Plate Seam. Set lap in beds of sealant.
- G. Parapet Cap Flashing – Option C:
 1. Where short runs of wall allow for few joints or as otherwise elected, Contractor may provide the following system in lieu of site fabricated assembly:
 - a. [Perma-Tite Double Tapered Coping System](#) by [Metal Era, LLC](#). 20 gauge galvanized steel snap-on clip system.
 - b. Color: Refer to Drawings.
- H. Curb-Mounted Refrigeration Line Hood: Install galvanized sheet metal hood with gasketed fasteners at 8 inches on center and as indicated on Drawings. Seal all joints in hood and pipe penetrations to provide weatherproof enclosure.
- I. Curb-Mounted Multiple Vent Hood: Install galvanized sheet metal hood with gasketed fasteners at 8 inches on center and as indicated on Drawings. Seal all joints in hood and pipe penetrations to provide weatherproof enclosure.
- J. Reglet and Counterflashing System:
 1. Surfaced Mounted Reglet:
 - a. Set reglet parallel to roof line in full bed of sealant. Provide minimum 2 inch end lap at continuous elevations.
 - b. Secure to wall with neoprene/stainless steel washers and drive pins at maximum 16 inches on center.
 - c. Provide a continuous, full bead of sealant at top edge of reglet between flashing and wall. Sealant bead shall be of sufficient width to provide a 45 degree angle with vertical surface.
 2. Counterflashing: Provide counterflashing of the type indicated or required to match reglet system. Insert counterflashings into reglets to form tight fit. Counterflashing shall be installed in such a manner as to provide for continuous contact at base flashing with sufficient pressure at point of contact to prevent dislocation. Lap inside corners. Notch and hook-seam outside corners. Set laps and seams in sealant.
 - a. Provide minimum 2 inch end lap at continuous elevations.
 - b. Change in elevation of 4 inches, provide 8 inch end lap.
 - c. Change in elevation of 8 inches, provide 12 inch end lap.

END OF SECTION

SECTION 07711 (07 7113) - GUTTERS AND DOWNSPOUTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gutters and downspouts, with expansion joints.
2. Downspout collectors.
3. Conductor heads.

B. Related Requirements:

1. Section 07620 - Sheet Metal Flashings and Trim.
2. Section 07710 – Manufactured Roof Specialties: Roof edge fascia system.
3. Section 07900 - Joint Sealers.
4. Section 09900 - Paints and Coatings: Field painting of metal surfaces.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Architectural Manufacturers Association (AAMA)

1. AAMA 621 - High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates

C. ASTM International (ASTM):

1. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
3. ASTM A 792 - Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. Architectural Sheet Metal Manual.

E. Steel Structures Painting Council (SSPC):

1. SSPC - Paint 12 - Cold-Applied Asphalt Mastic (Extra Thick Film).

1.3 QUALITY ASSURANCE

A. Nominal sizing of components for rainfall intensity determined by a storm occurrence of 1 in 5 years shall be as indicated on Drawings.

1.4 DELIVERY, STORAGE AND HANDLING

A. Stack preformed materials to prevent twisting, bending, or abrasion, and to aid ventilation. Slope to drain.

B. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653 Structural Quality, Grade 33, G90 zinc coating, mill phosphatized for painting where exposed to view from ground level. Sheet metal components shall be galvanized steel sheet unless otherwise specified.
 - 1. Thermoplastic (TPO) Coated Sheet Metal for Through Wall Scuppers: ASTM A 653, Type B Commercial Steel, 24 gage, G90 zinc coating, with a layer of .035 inch min non-reinforced membrane flashing. Color shall match TPO roof color.
 - a. Sure-Weld Coated Metal by Carlisle or equivalent.

2.2 COMPONENTS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. SMACNA rectangular profile, Figure 1-2, Style D, gauge as follows:
 - 1. 12 inches x 12 inches: 22 gauge.
 - 2. 10 inches x 10 inches: 22 gauge.
 - 3. 8 inches x 8 inches: 22 gauge.
 - 4. 6 inches x 6 inches: 24 gauge.
 - 5. 5 inches x 5 inches: 24 gauge.
 - 6. 4 inches x 4 inches: 24 gauge.
- B. Prefinished Metal Gutters: 24 gage; Aluminum-Zinc Alloy-Coated Steel Sheet, ASTM A 792/A, Class AZ50 coating designation, Grade 40, structural quality, UL90 rated panels, and prepainted by the coil-coating process to comply with ASTM A 755/A.
 - 1. Finish: Smooth panel with factory finished baked-on fluoropolymer 2-coat coating system consisting of manufacturer's standard 2-Coat Fluoropolymer conforming to AAMA 621. Fluoropolymer finish containing not less than 70 percent Kynar 500 PVDF resin by weight in color coat with a minimum of 0.9 mil dry film thickness. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color:
 - a. PF-4 (Dark Zinc): Match Lead-Cote Metallic by Berridge.
 - b. PF-14: Match Slate Gray by Metal Era.
- C. Downspouts: 22 gauge, Class AZ50 coating designation, Grade 40, SMACNA rectangular unless otherwise indicated, mitered elbows, fully enclosed profile, SMACNA Figure 1-32B.
 - 1. Finish: Factory finished baked-on fluoropolymer 2-coat coating system consisting of manufacturer's standard 2-Coat Fluoropolymer conforming to AAMA 621. Fluoropolymer finish containing not less than 70 percent Kynar 500 PVDF resin by weight in color coat with a minimum of 0.9 mil dry film thickness. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Color: PF-14: Match Slate Gray by Metal Era.
- D. Conductor Head: SMACNA Figure 1-25F.

2.3 ACCESSORIES

- A. Gutter Brackets: Galvanized steel plate, 3/16 inch thick by 2 inches wide bent plate.
- B. Gutter Spacer Strap: Galvanized steel sheet size and spacing as shown.
- C. Downspout/Gutter Connections: Match gauge and profile of gutter, SMACNA Figure 1-33B, Detail 1.

- D. Downspout Straps: Match downspout material, minimum 20 gauge, SMACNA Figure 1-35G.
- E. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15 mil dry film thickness per coat.
- F. Sealant: Specified in Section 07900.
- G. Splash Blocks (if indicated on Drawings): Precast concrete units, minimum 3000 psi at 28 days, with 5 percent air entrainment, size and profile to suit application.
- H. Downspout Collectors (if indicated on Drawings): Pipe material, sizes, connections, dimensions and profiles to suit downspouts and underground storm drainage system as indicated on drawings.

2.4 FABRICATION

- A. Form gutters and downspouts of size as indicated on Drawings.
- B. Fabricate in accordance with SMACNA details unless otherwise shown.
- C. Provide gutter spacers at spacing shown. Fasten to front and back of gutter.
- D. Field measure site conditions prior to fabricating work.
- E. Form sections square, true, and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- F. Hem exposed edges of metal.
- G. Field Finishing: Field paint gutters, downspouts, and accessories surfaces exposed to view from ground surface unless noted as prefinished or unpainted on Drawings. Paint in accordance with Section 09900.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and conditions are acceptable.
- B. Verify surfaces behind gutters and downspouts are painted prior to installation. Gutters, downspouts, and conductor heads shall not be in place while surfaces behind such items are being painted.

3.2 INSTALLATION

- A. Install gutters, brackets, and accessories in accordance with SMACNA Figure 1-12 and as shown on the Drawings.
 1. Install gutters level without sags or dips to prevent ponding.
 2. Gutter Brackets: Space alternately with gutter spacers at 36 inches on center.
 - a. Attachment to Masonry: Anchor to masonry bond beam as shown. Space anchor bolts minimum of 3 inches apart.
 - b. Attachment to Steel: Weld to steel tube section with 3/16 inch by 2 inches fillet weld, both sides of bracket. Begin weld at top of bracket.
 3. Lap gutter joints 2 inches, set laps in bead of sealant, and rivet at 1 inch on center.
 4. Provide lap type gutter expansion joint in accordance with SMACNA Figure 1-6. Locate joints at a maximum spacing of 40 feet with at least one expansion joints in each segment of gutter between ends and/or downspouts.
- B. Install downspouts in accordance with SMACNA Figure 1-35G, space straps at 48 inches on center.
- C. Install conductor heads and downspouts after application of exterior wall coating.

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- D. Apply bituminous coating on backside of conductor heads, gutters, and downspouts and on other gutter, downspout, and accessories surfaces in contact with dissimilar materials, masonry, and preservative treated wood.

END OF SECTION

SECTION 07721 - MANUFACTURED CURBS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured structural metal roof curbs.
2. Manufactured non-structural metal roof curbs.
3. Coordination with manufacturers and suppliers of roof mounted items and equipment.

B. Related Requirements:

1. Section 05120 - Structural Steel: Roof opening frames and headers.
2. Section 05210 - Steel Joists: Joists supporting roof curbs.
3. Section 07620 - Sheet Metal Flashing Trim: Sheet metal flashing installed in conjunction with roof penetration curbs.
4. Section 15700 - Heating, Ventilating and Air Conditioning Equipment.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Welding Society (AWS): AWS D1.1 - Structural Welding Code.
- C. Steel Structures Painting Council (SSPC):
 1. SSPC-Paint 20 Zinc Rich Coating Type I - Inorganic and Organic.

1.3 DEFINITIONS

- A. Structural Roof Curb: Manufactured square or rectangular roof curb, bearing on structural steel joists or headers, designed to support equipment dead load and roof dead and live loads.
- B. Non-Structural Roof Curb:
 1. Deck Penetrations - 10 Inches by 10 Inches or Less: Manufactured square or rectangular roof curb, bearing on top of metal roof deck, designed to receive sheet metal flashing skirt, not used for support of equipment.
 2. Deck Penetrations - Greater Than 10 Inches by 10 Inches: Manufactured square or rectangular roof curb bearing on structural steel angle frame, designed to support equipment dead load. Roof dead and live load supported by structural angle frame.
 3. Expansion Joints: Manufactured linear roof curb, bearing on top of metal roof deck, designed to receive expansion joint cover.

1.4 QUALITY ASSURANCE

- A. Qualifications for Welding Work: Qualify field welding operators in accordance with AWS Standard Qualification Procedures. Provide certification that field welders have satisfactorily passed AWS qualification tests within previous 12 months.
 1. If recertification of welders is required, provide without additional cost to Wal-Mart.
- B. Structural Curbs: Provide manufactured metal roof curbs designed by a licensed engineer. Meet or exceed Live Loads and Dead Loads as specified in this Section and as indicated on Drawings. Coordinate curb dimensions with shop drawings of equipment to be supported.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- B. Ship curbs to site palletized and banded.
- C. Curb manufacturer shall furnish Curb Schedule to Contractor identifying curb "Type" and roof penetration for which curb is to be used. Curb Schedule shall identify identical curbs as single "Type" (i.e. Type A - 10 ton RTU's, Type B - 5 ton RTU's, etc.). Identify each curb with "Type" designation painted in 1 inch high letters on outside face of curb.
- D. Stack curbs at site to prevent twisting, bending or permanent deformation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Steel: One of the following at Contractor's option:
 - 1. Galvanized Steel Sheet: ASTM A 653, SS (Structural Steel) Classification, Grade 33, G60 hot-dip zinc coating.
 - 2. Aluminum-Coated Steel Sheet: ASTM A 463, SS (Structural Steel) Classification, Grade 33, Type 2, T2 100 aluminum coating.
 - 3. Aluminum Zinc Alloy-Coated Steel Sheet (GAVALUME): ASTM A 792, AZ55 aluminum zinc alloy coating.
- B. Board Insulation: Specified in Section 07210, as applicable.
- C. Wood Nailers: CCA Pressure Treated Lumber Type C, "Standard" grade lumber of any species.
- D. Zinc-Rich Primer: SSPC-Paint 20 Type II.
- E. Deck Support Clip: Galvanized steel sheet, gauge as shown.

2.2 STRUCTURAL ROOF CURBS

- A. Fabrication, General: Coated 14 gauge steel sheet curb sections, corners fully mitered and welded; 2 inch by 4 inch (nominal dimension) pressure treated continuous wood nailers mechanically fastened with corrosion resistant fasteners at 12 inches on center to exterior face of curb. Shop prime welded connections with zinc-rich paint complying with SSPC-Paint 20.
- B. Adapter Curbs: Curbs shall be fully welded and insulated. Blank off open areas not used for supply and return air to prevent air mixing. Construct adapter curbs with the minimum height required to achieve proper airflow. Verify curb type, size, and unit prior to fabrication.
- C. Curb Height: Unless otherwise required by local codes, minimum curb height from top of bar joist to top of curb shall be as specified below but in no case less than 8 inches from top of roof membrane to top of curb:
 - 1. All Rooftop Unit Curbs Unless Otherwise Shown or Specified: 18 inches.
 - 2. Pre-fabricated Pump Package Curbs and Fluid Cooler Curbs: 14 inches.
 - 3. Refrigeration Line Curbs: 15 inches.
- D. Reinforce curb sections as required for design loads indicated on Drawings.
- E. Welding: AWS D1.1.
- F. Mechanical unit curbs: Label curbs with "FRONT" designating the curb orientation to the front of facility prior to shipment. Mechanical unit curbs will be provided as follows as applicable:

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1. Roof Top Unit (RTU) Curbs: Provide continuous height rail curbs. It is acceptable for units to follow roof slopes not exceeding 1/4 inch per foot, unless noted otherwise on structural drawings.
 2. Make-Up Air Unit (MAU) Curbs: Provide tapered rail curbs. Construct curb for MAU to be level (verify roof slope).
 3. Air Handling Unit (AHU) Curbs: Provide tapered rail curbs. Construct curb for AHU to be level (verify roof slope).
 4. Condensing Unit (CU/RCU) Curbs: Provide tapered rail curbs. Construct curb for CU/RCU to be level (verify roof slope).
- G. Refrigeration Line Curbs and Weather Hood: Provide continuous height rail curbs. It is acceptable to follow roof slopes not exceeding 1/4 inch per foot, unless noted otherwise on Structural drawings. Provide curb for required opening for refrigerant piping and electrical conduit. Provide 18 gauge weather hood sized to fit curb with pre-molded neoprene gasket and closure plates.
- H. Duct Opening Curbs at AHU on Structural Frame Above Roof: Provide tapered curb for required duct openings between bottom of elevated AHU on structural frame and roof. Construct curb for AHU to be level (verify roof slope).

2.3 NON-STRUCTURAL ROOF CURBS

- A. Coated 18 gauge steel sheet curb sections, corners fully mitered and welded; 2 inch by 4 inch (nominal dimension) pressure treated continuous wood nailers mechanically fastened at 12 inches on center to exterior face of curb. Shop prime welded connections with zinc-rich paint complying with SSPC-Paint 20. Profile and dimensions shall be as shown.
1. Web Height: Comply with local code requirements for minimum curb height, but in no case shall curb height be less than 18 inches for deck penetrations greater than 10 inches by 10 inches and not less than 14 inches for deck penetrations 10 inches by 10 inches or less as measured from top of steel roof deck to top of curb, nor shall curb height be less than 8 inches as measured from top of roof membrane to top of curb.
- B. Expansion Joints: Coated 14 gauge steel sheet curb sections; 2 inch by 4 inch (nominal dimension) pressure treated continuous wood nailers mechanically fastened at 12 inches on center to exterior face of curb.
1. Bottom Flange Width: 9 inches
 2. Web Height: Comply with local code requirements for minimum curb height, but in no case shall curb height be less than 16 inches as measured from top of steel roof deck to top of curb, nor shall curb height be less than 8 inches as measured from top of roof membrane to top of curb.

2.4 WIND/SEISMIC RESTRAINT BRACKETS

- A. When noted on the Mechanical Rooftop Unit or Air Handling Unit Schedules, furnish wind and seismic restraint brackets with curbs for anchorage of rooftop equipment to curbs.

2.5 STRUCTURAL ROOF CURB SCHEDULE

- A. Structural Curbs:
1. HVAC roof top units (RTU).
 2. Make-up Air Units (MAU).
 3. Air Handling Units (AHU).
 4. Condensing Unit Curb (RCU and CU).
 5. Refrigeration lines penetrating roof.
 6. Duct openings between bottom of elevated AHU on structural frame and roof.

2.6 NON-STRUCTURAL ROOF CURB SCHEDULE

- A. Provide non-structural roof curbs for the following items:
1. Exhaust fans, unless otherwise shown to be provided by others.
 2. Multiple vent pipe penetrations.

2.7 SUBSTITUTIONS

- A. Comply with the requirements of Section 01600.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install curbs in accordance with manufacturer's instructions and as indicated on Drawings. Coordinate installation with roof membrane installation requirements specified under other Sections.
- B. Roof Curbs Bearing on Steel Angles, Joists, and Headers:
 - 1. Set units in place and secure base to roof structure by welding to top chord of structural member or as otherwise indicated on Drawings.
 - 2. Secure metal deck to perimeter of curb as indicated on Drawings.
- C. Roof Curbs Bearing on Roof Deck:
 - 1. Set units in place and secure base to steel roof deck by self-tapping screw fasteners spaced at a maximum of 12 inches on center, staggered.
- D. Install wind/seismic restraint brackets prior to installation of rooftop equipment in accordance with manufacturer's recommendations.

3.2 COORDINATION

- A. Coordinate project requirements for custom adapting and connecting to roof curbs with manufacturers and suppliers of curb mounted items and equipment.

END OF SECTION

SECTION 07722 - ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefabricated roof hatch, with integral support curbs, operable hardware, and counterflashings.
- B. Related Requirements:
 - 1. Section 05500 - Metal Fabrications: Shop fabricated roof hatch ladders, Hatch Grip ladder safety extension, and other ferrous metal items.
 - 2. Section 05510 - Metal Stairs and Ladders: Requirements for manufactured or shop fabricated metal ships ladder access to roof hatch.
 - 3. Section 09900 - Paints and Coatings: Exterior field painting of roof hatch.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with project requirements, provide specified items by one of the following manufacturers:
 - 1. [Babcock Davis](#), Brooklyn Park, MN (888) 412-3726.
 - 2. [The Bilco Company](#), New Haven, CT (800)366-6530.
 - 3. [Milcor](#), Carol Stream, IL (800) 624-8642.
 - 4. [Precision Ladders, LLC](#), Morristown, TN. (800) 225-7814.

2.2 ROOF HATCH – EQUIPMENT ACCESS

- A. Model:
 - 1. Model B-RHG 4848T (Galv) or B-RHA 4848T (Alum) by Babcock-Davis.
 - 2. Model F (Alum) by Bilco.
 - 3. Model M-7 (Galv) by Milcor.
 - 4. Model PSRH-G (Galv) or PSRH-A (Alum) by Precision Ladders.
- B. Description:
 - 1. Size: 4 feet by 4 feet.
 - 2. Curb: As shown; integral cap flashing to receive roof flashing system; extended flange for mounting.
 - 3. Cover: Aluminum or steel.
 - 4. Hardware: Manufacturer's standard manually operated type with compression spring operators, positive snap latch with turn handles inside and out and padlock hasps outside; automatic hold-open arm with vinyl covered grip handle for easy release; cadmium plated finish.
 - 5. Hinges: Heavy duty pintle type.
 - 6. Fasteners: Corrosive resistant fasteners recommended by roof hatch manufacturer. Provide neoprene sealing washers.

2.3 FABRICATION

- A. Fabricate roof hatches free of visual distortions and defects. Weld corners and joints.
- B. Fabricate roof hatches weathertight with integral capflashing, providing for removal of condensation.
- C. Finish:
 - 1. Galvanized Steel: Prime paint, one coat for field finish painting or shop powder coated.
 - 2. Aluminum: Unpainted mill finish.

- D. Spot weld hasp, latch and hinges to prevent removal from interior.

2.4 ROOF HATCH LADDER

- A. Steel Wall Ladder: As specified in Section 05500 - Metal Fabrications.
- B. Ladder Safety Extension: Hatch Grip safety extension as specified in Section 05500 - Metal Fabrications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions. Coordinate with installation of roofing system and related flashings. Provide weathertight installation.
- B. Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.
- C. Field paint exterior exposed areas of hatch as specified in Section 09900.
- D. Interface with Other Work:
 - 1. Coordinate location and required clear dimensions of roof deck opening.
 - 2. Coordinate locations of steel roof structure members for attachment of roof hatch curbs.
 - 3. Coordinate with installation of roof insulation, roof membrane and related flashings.

3.2 FIELD QUALITY CONTROL

- A. Inspect roof hatch installation and attachment to structure.
- B. Adjust hatch hinge and hold-open arm for smooth operation.

END OF SECTION

SECTION 07815 - MINERAL FIBER FIREPROOFING – Add Section

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Mineral fiber blanket fireproofing.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E119 - Method For Fire Tests of Building Construction and Materials.
 3. ASTM E 2336 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

1.3 SEQUENCING

- A. Sequence and coordinate installation of mineral fiber blanket fireproofing with other, related construction specified in other sections to comply the following requirements:
1. Avoid unnecessary exposure of mineral fiber blanket fireproofing to abrasion and other damage likely to occur during construction operations subsequent to its application.
 2. Do not install enclosing or concealing construction until after mineral fiber blanket fireproofing has been applied and inspected by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements of this Section, provide mineral fiber fireproofing as manufactured by one of the following:
1. Unifrax, Niagara Falls, NY, (716) 278-3800.
 2. Thermal Ceramics, Atlanta, GA, (706) 796-4200.
 3. 3M Corporation, Building and Commercial Services Division, St. Paul, MN, (800) 328-1687.

2.2 PERFORMANCE CRITERIA

- A. Fire Performance Characteristics:
1. Surface Burning Characteristics: ASTM E 84.
 - a. Flame Spread (Max): 25.
 - b. Smoke Developed (Max): 50
- B. Grease Duct Fire Resistance: Duct wrap shall meet the fire resistance standards for a two-layer grease duct enclosure system when tested in accordance with ASTM E2336.

2.3 MATERIALS

- A. Mineral Fiber Blanket Fireproofing: Ceramic or glass fiber blanket covered with polypropylene or fiberglass scrim foil facing. Provide one of the following products:
1. 3M Fire Barrier Duct Wrap 15A, by 3M.
 2. FyreWrap Elite 1.5, by Unifrax.

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3. FireMaster Fast Wrap XL, by Thermal Ceramics.
- B. System Thickness: 2 layers of 1-1/2 inch blanket.
 - C. Nominal Density/Thermal Resistivity: 8 pcf/4.15 at 70 deg F.
 - D. Anchorage Accessories: For each fire resistive assembly in which mineral fiber blanket serves as fireproofing, provide manufacturer's standard blanket-anchorage system complying with related design of UL or other testing and inspecting organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas in which Work under this Section is to be performed. Report in writing to the Construction Manager prevailing conditions that may adversely affect satisfactory execution of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Starting Work constitutes acceptance of the existing conditions and this Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective Work encountered.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions for particular conditions of installation in each case. Consult with manufacturer's technical representative for conditions not covered by printed instructions.
- B. Install fireproofing blanket to comply with requirements for thickness, number of courses (layers), construction of joints and corners, and anchorage methods that apply to fire resistance systems specified.

3.3 PROTECTION

- A. Coordinate installation of fireproofing with other construction to minimize cutting into, or removal of, installed fireproofing. As other construction is successively completed, replace or repair fireproofing installations which have been cut away to facilitate this other construction. Maintain complete coverage of full thickness on members and substrates protected by fireproofing.
- B. Provide final protection and maintain conditions in a manner acceptable to Installer, Manufacturer, and authorities having jurisdiction that ensures mineral fiber blanket fireproofing being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 07840 - FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Firestopping in rated assemblies.
- B. Related Sections:
 - 1. Section 09250 - Gypsum Board.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM E814 - Test Methods for Fire Tests of Through Penetration Fire Stops.
- C. FM Global (FM):
 - 1. FM 4991 – Standard for the Approval of Firestop Contractors
- D. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 2. UL 2079 – Tests for Fire Resistance of Building Joint Systems.
 - 3. UL Fire Resistance Directory:

1.3 SUBMITTALS

- A. Submittals: Comply with the requirements of Section 01330.
- B. Certifications:
 - 1. Installer Qualifications. Submit documentation of Designated Responsible Individual (DRI) or letter from firestop manufacturer naming approved installer to Architect prior to commencement of firestop work.
 - 2. Manufacturer's Inspection. Submit written certification from firestop manufacturer that Manufacturer's Representative has visited Site as specified in Part 3 and Work is in accordance with manufacturer's requirements and published instructions.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installation of firestopping shall be by a Designated Responsible Individual (DRI) in accordance with FM 4991 or shall be an approved installer by the Firestop Manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide firestopping products as manufactured by one of the following:
 - 1. Nelson Firestop Products, (800) 331-7325.
 - 2. Hilti, Inc, (800) 879-8000.

3. RectorSeal Corporation, (800) 231-3345.
4. Specified Technologies, Inc. (STI), (800) 992-1180.
5. 3M Fire Protection Products, (800) 376-0964.
6. Tremco Firestop System, (800) 852-8173.

2.2 REGULATORY REQUIREMENTS

- A. Firestop materials shall have been tested with and shall be in compliance with the minimum requirements of ASTM E814, UL 1479, and UL 2079 as applicable. Products used shall be as listed below as suitable for the intended application and as required to produce the fire rating as shown on the drawings and to conform to the Firestopping Schedule of UL assemblies included at the end of this Section.

2.3 MATERIALS

- A. Intumescent Latex or Acrylic Sealant: Single-component, intumescent, latex or acrylic formulation.
 1. LBS, by Nelson Firestop Products.
 2. FS ONE or CP 606, by Hilti.
 3. Metacaulk 950 or 1000, by RectorSeal.
 4. SpecSeal SSS100, by STI.
 5. CP 25WB+, IC 15WB, or 3000WT by 3M.
 6. TREMstop Intumescent Acrylic (IA) or Acrylic (A), by Tremco.
- B. Intumescent Wrap/Strip: Single-component, elastomeric sheet with aluminum foil on one face.
 1. WRS, by Nelson Firestop Products.
 2. CP 648 Wrap Strip, by Hilti.
 3. Metacaulk Wrap Strip, by RectorSeal.
 4. SpecSeal SSWRED Wrapstrip, by STI.
 5. FS-195+ Wrap/Strip or Ultra GS, by 3M.
 6. TREMstop WS, by Tremco.
- C. Intumescent Putty: Single-component, non-hardening, dielectric, intumescent putty.
 1. FSP, by Nelson Firestop Products.
 2. CP 618 Putty Stick or CP 617/617L Putty Pad, by Hilti.
 3. CP 648 Wrap Strip, by Hilti.
 4. CFS-PL Firestop Plug, by Hilti.
 5. Metacaulk Fire Rated Putty, by RectorSeal.
 6. SpecSeal Putty, by STI.
 7. Moldable Putty+, by 3M.
 8. TREMstop MP (Moldable Putty) or Putty Stick by Tremco.
- D. Silicone Sealant: Single-component, moisture-curing, silicone-based elastomeric, non-sag grade.
 1. CLK N/S, by Nelson Firestop Products.
 2. CP 601S, by Hilti.
 3. Metacaulk 835, by RectorSeal.
 4. SpecSeal PEN 300, by STI.
 5. 2000+ Silicone, by 3M.
 6. FYRE SIL, by Tremco.
- E. Silicone or Polyurethane Foam: Two-Component, liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.
 1. SpecSeal PEN 200, by STI.
 2. CP 620 Fire Foam, by Hilti.
- F. Intumescent Collar: Factory-fabricated, intumescent collar.
 1. PCS, by Nelson Firestop Products.
 2. CP 643 or CP 644, by Hilti.
 3. Metacaulk Pipe Collar, by RectorSeal.
 4. SpecSeal SSC Collars, by STI.
 5. Plastic Pipe Device, Ultra Plastic Pipe Device, Tuck In Wrap Strips, or RC-1 Collar by 3M.

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- 6. TREMstop D, by Tremco.
- G. Intumescent Composite Sheet, Pillows and Mortar, or Blocks: Products used to firestop large openings.
 - 1. CPS, by Nelson Firestop Products.
 - 2. CFS-BL Fireblocks, by Hilti.
 - 3. CP 637 Firestop Mortar, by Hilti.
 - 4. CP 675T Firestop Board, by Hilti.
 - 5. SpecSeal SSB Pillows and SpecSeal SSM Firestop Compound, by STI.
 - 6. CS-195+ Composite Sheet, by 3M.
 - 7. TREMstop PS, by Tremco.
- H. Sprayable Fire-Rated Mastic: Products used to firestop construction joints.
 - 1. CP672 Speed Spray, by Hilti.
 - 2. Specseal Elastomeric Spray, by STI.
 - 3. Firedam Spray 200, by 3M
 - 4. TREMstop Acrylic Spray (A-SP) by Tremco.
- I. Packing Material: Manufacturer's standard mastic, putty, ceramic fiber blanket, or mineral wool to be used as fill or backing material for firestopping.
 - 1. Mineral Wool, by Nelson Firestop Products.
 - 2. Mineral Wool, by Hilti.
 - 3. Fire Safing or Backer Rod, by RectorSeal.
 - 4. Mineral Wool, by STI.
 - 5. Fire Barrier 5A, 615+ Duct Wrap, or PM4 Packing Material by 3M.
 - 6. TREMstop FS Blanket, by Tremco.
 - 7. CP 767 Speed Strips and CP 777 Speed Plugs, by Hilti. (preformed mineral wool designed for top of wall fluted metal deck packing material)
- J. Substitutions: Comply with the requirements of Section 01600.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove loose dirt and oil from penetration surfaces.
- B. Place hangers or damming materials in penetration to hold firestopping materials, if necessary.

3.2 INSTALLATION

- A. Keep caulk and putty away from heat, open flame, sparks, or other sources of ignition during application and until product cures. Use only with adequate ventilation.
- B. Follow manufacturer charts for appropriate material to achieve required fire rating in various locations.
- C. Install firestopping at penetrations of fire rated wall materials in accordance with manufacturer's published instructions.
- D. Install firestopping at penetrations and construction joints of fire rated walls and floors in accordance with manufacturer's published instructions and in accordance with UL Fire Resistance Directory.

3.3 FIELD QUALITY CONTROL

- A. Site Inspection: Upon completion of installation, , Manufacturer's Representative shall inspect installed firestopping to verify work complies with the manufacturer's requirements.

3.4 FIRESTOPPING SCHEDULE

A. Provide firestopping complying with UL assemblies specified below.

Penetration	Assembly	Nelson	Hilti	RectorSeal	STI	3M	Tremco
Metal Pipe	CMU Wall 8" Thick or Less	CAJ1203	CAJ 1149 or CAJ1155 or CAJ1226	CAJ1114 or CAJ1115	CAJ1079 or CAJ1217	CAJ1001 or CAJ1009	CAJ1064 or CAJ1302
	Gypsum Board Partition	WL1083 or WL1030	WL1054 or WL1058 or WL1297	WL1026 or WL1034	WL1049 or WL1079	WL1003 or WL1009	WL1278 or WL1158
Non-Metallic Pipe	CMU Wall 8" Thick or Less	CAJ2086	CAJ2110 or CAJ2109 or CAJ2567	WJ2025	CAJ2064 or CAJ2045	CAJ2005	CAJ2223 or CAJ2184
	Gypsum Board Partition	WL2071	WL2098 or WL2078 or WL2341	WL2104	WL2093, WL2029 or WL2288	WL2002 or WL2005	WL2083 or WL2129
Cable Tray	CMU Wall 8" Thick or Less	CAJ8049 or CAJ4033	CAJ4035 or CAJ4017	CAJ8043	CAJ4020 or CAJ4029	CAJ4003	CAJ4075
	Gypsum Board Partition	WL4003	WL4011 or WL4019	----	WL4005 or WL4008	WL4004	WL3043 or WL3131
Insulated Metal Pipe	CMU Wall 8" thick or Less	CAJ5008 or CAJ5059	CAJ5090 or CAJ5091 or CAJ5048	WJ5016 or CAJ5070	CAJ5021 or CAJ5029	CAJ5001 or CAJ5002	CAJ5121 or CAJ5111
	Gypsum Board Partition	WL5036	WL5028 or WL5029 or WL5257	WL5057	WL5014 or WL5051	WL5001	WL-5115 WL-5081
Construction Gaps - Head of Wall to Roof Deck	CMU Wall to Metal Deck	----	HWD0098 or HWD0181 or HWD1037	HWD0235	----	HWD0013	HWD0092
	Gyp Bd Parti'n to Metal Deck	----	HWD0042 or HWD0049	HWD0014	----	HWS0003	HWD0091
Construction Gaps - Wall to Wall	CMU Wall to CMU Wall	----	WWD1011 or WWD1012 or WWD1017	----	----	WWS1001	WWD1050, WWD0043, TL/PV60-01 or WWD-1052
	Gyp Bd Parti'n to Gyp Bd Parti'n	----	WWD0067	----	----	WWS0004	----

END OF SECTION

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joint sealants for exterior joints in vertical surfaces and horizontal nontraffic surfaces, except as otherwise specified.
 - 2. Joint sealants for interior vertical surfaces and horizontal nontraffic surfaces, except as otherwise specified.
 - 3. Joint sealants and fillers in interior concrete floor slab-on-grade joints.
 - 4. Joint sealant and fillers in exterior concrete sidewalks and pavement adjacent to building.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 01351 – Regulatory Compliance.
 - 2. Division 2: Joint fillers and sealants for joints in sidewalk and pavement not adjacent to building.
 - 3. Section 07500 - Membrane Roofing: Sealants associated with roofing.
 - 4. Section 07840 - Firestopping: Joint seals around penetrations of fire-rated assemblies.
 - 5. Section 09650 - Resilient Flooring: Joint filler for control/construction joints concealed by floor finish material.
 - 6. Section 09900 - Paints and Coatings: Protection of wall joints from painting prior to sealing.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C920 - Specification for Elastomeric Joint Sealants.
 - 2. ASTM C1330 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 3. ASTM D 1056 - Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 4. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
- C. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

1.4 QUALITY ASSURANCE

- A. Interior sealants in food preparation areas shall meet the compositional requirements for use in USDA regulated facilities, as required by FDA according to 21 CFR 177.2600, and local authorities having jurisdiction.

1.5 SCHEDULING

- A. Complete the exterior wall sealant manufacturer's Exterior Wall Sealant Order Form provided in Excel format by Walmart Facilities Maintenance. Contact Audrey Freeman, (501) 516-6815, audrey.freeman@walmart.com.
- B. Submit Order Form to Walmart Facilities Maintenance a minimum of 3 weeks prior to beginning exterior wall sealant work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store and protect products in compliance with the requirements of Section 01600.

- B. Supplier will deliver exterior wall joint sealants to site to be received by Contractor. Coordinate product delivery and installation in compliance with the delivery requirements of Section 01600.

1.7 PROJECT CONDITIONS

- A. Do not install solvent curing sealants in enclosed building spaces.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.
- C. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 ELASTOMERIC SEALANTS - GENERAL

- A. Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.2 ELASTOMERIC SEALANTS (EXTERIOR WALL)

- A. Provide Sealant for Exterior Wall Control and Expansion Joint as follows:
 - 1. L1: Multi Component Sealant (for joint width not exceeding 1-1/2 inch and joint depth not exceeding 1/2 inch): Non-sag, Class 50. Provide the following:
 - a. [MasterSeal NP 100](#) by Master Builders Solutions.
 - b. Container Size and Color:
 - 1) Custom Color Sealants: 1.5 Gal Pail.
 - 2) Limestone (Stock Color Gray): 1.5 Gal Pail or 20 oz sausage (not typical for vertical wall).
 - 3) Match adjacent finish color if exterior color scheme is non-prototypical.

2.3 ELASTOMERIC SEALANTS (EXTERIOR APPLICATIONS OTHER THAN EXTERIOR WALL)

- A. Elastomeric Sealant for Concrete Sidewalk or Paving Joint at Building:
 - 1. L2: Multi-Component Sealant (for joint width not exceeding 3 inches and joint depth not exceeding 1/2 inch): Non-sag or self-leveling, Class 50: Provide the following:
 - a. MasterSeal NP 100, by Master Builders Solutions.
 - b. Color:
 - 1) Limestone (Stock Color Gray): 1.5 Gal Pail or 20 oz sausage.
 - 2) Match adjacent finish color if exterior color scheme is non-prototypical.

2.4 ELASTOMERIC SEALANTS (APPLICATIONS OTHER THAN EXTERIOR WALL)

- A. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600. Sealants identified as (Non-USDA) shall not be used in food preparation areas.
- B. Manufacturers:
 - 1. [Sonneborn Products](#) by BASF Building Systems. (800) 433-9517 or (952) 496-6000.
 - 2. [Dap Products, Inc.](#), (800) 325-6180.
 - 3. [Dow Corning Corporation](#). Mary Altenburg, (989) 496-7767.
 - 4. [Euclid Chemical Co.](#), (877) 438-3826.
 - 5. [GE Silicones](#) & GE Sealants and Adhesives. (Momentive Performance Materials) (877) 943-7325.
 - 6. [HI-TECH Systems](#) (800) 454-5530.
 - 7. [Metzger/McGuire](#), (800) 223-6680.
 - 8. [Master Builders Solutions, LLC](#). Contact: Zach Duggan, (612) 590-3719, zachary.duggan@mbcc-group.com

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- or Chris Lebo, (216) 318-2529, chris.lebo@mbcc-group.com.
9. [Pecora Corporation](#), (215) 796-1401, Keith Waters.
 10. [Tremco Sealant](#)/Weatherproofing Division. (800) 841-3778.
 11. [VersaFlex Inc.](#), (913) 321-1416.
 12. [W. R. Meadows, Inc.](#), (847) 214-2100.

C. Polyurethane and Hybrid Sealants (USDA Certified, unless otherwise noted):

1. Hybrid Sealant #1 (P1): ASTM C920, Type S, Grade NS, Class 50, single component.
 - a. MasterSeal NP 100, by Master Builders Solutions.
 - b. Vulkem 116 or Dymonic FC by Tremco.
 - c. Dynatrol I-XL or Dynatrol I-XL Hybrid, by Pecora.
2. Polyurethane Sealant #2 (P2): ASTM C920, Type S, Grade P, Class 25, single component.
 - a. MasterSeal SL 1, by Master Builders Solutions.
 - b. Vulkem 45 (Non-USDA), by Tremco.
 - c. Urexpam NR-201, by Pecora.
3. Polyurethane Sealant #3 (P3): ASTM C920, Type M, Grade NS, Class 50, multi-component.
 - a. MasterSeal NP2, by Master Builders Solutions.
 - b. Dymeric 240FC, by Tremco.
 - c. Dynatrol II (Non-USDA) by Pecora.

D. Silicone Sealants: USDA compliant, unless otherwise noted.

1. Silicone Sealant #1 (S1): ASTM C 920, Type S, Grade NS, Class 25.
 - a. Spectrem 1, Spectrem 2 or Spectrem 3 by Tremco.
 - b. 791 Silicone Perimeter Sealant (Non-USDA) by Dow.
 - c. 864 or 890 by Pecora.
 - d. MasterSeal NP 150 by BASF - Sonneborn.
 - e. SilPruf SCS2000 (Non-USDA) by GE.
 - f. Titebond 100% Silicone Sealant by Franklin International.
2. Silicone Sealant #2 (S2): ASTM C 920, Type S, Grade NS, Class 25, mildew resistant.
 - a. Tremsil 200, by Tremco.
 - b. 898 by Pecora.
 - c. 786 Silicone Sealant (Non-USDA) by Dow.
 - d. Sanitary SCS1700 (Non-USDA) by GE.

E. Sealant Color:

1. In interior and exterior exposed areas, match color of adjacent paint color finish or other adjacent finish color if proprietary color is not otherwise specified herein.
2. In joints where plumbing fixtures meet adjacent floor and wall finishes, match color of plumbing fixture.
3. Use clear, colorless sealant where applied to stainless steel surfaces.

2.5 POLYURETHANE EXPANDING FOAM SEALANTS

- A. Polyurethane Expanding Foam Sealant #1 (EF1): Closed-cell foam and non-flammable propellant; urea formaldehyde-free, CFC-free; UL Class 1 Foam with flame spread of 20 and smoke developed of 25 as tested in accordance with ASTM E84.
- a. Touch'n Seal Quick Cure, by Dap Products.
 - b. Space Invader by GE Sealants & Adhesives, (877) 943-7325.

2.6 JOINT-SEALANT BACKING

- A. Sealant Backing (Backer Rod): Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Cylindrical Sealant Backings: Closed or bi-cellular backer rod conforming to ASTM C 1330, Type B or Type C, as approved by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance. The use of ASTM C Type O open cell backer rod is prohibited.
 - a. Backer Rod for Exterior Masonry: Closed cell foam, oversized 50 percent; self-expanding.

2. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056,
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 INTERIOR SLAB ON GRADE JOINT SEALANT MATERIALS

- A. Preformed Expansion (Isolation) Joint Filler Strips (PMEJ): Flexible closed-cell synthetic foam expansion joint strips, non-extruding, for full depth of concrete.
 1. Ceramar Flexibe Foam Expansion Joint, by W.R. Meadows.
 2. Deck-O-Foam Expansion Joint Filler, by W.R. Meadows
- B. Elastomeric Joint Materials:
 1. Sealant:
 - a. Polyurethane Sealant: No. 2 (P2) as specified above.
 - b. Color: Match color of adjacent exposed surface of concrete slab.
 - c. Sealant shall be compatible with construction material placed against it.
 2. Joint Back-Up Material:
 - a. Polyethylene Foam, 100% closed cell.
 - b. Material shall be compatible with construction material to be placed against it such as tile adhesive.
- C. Polyurea Joint Filler (PY1): Rapid setting, two-component polyurea polymer liquid of 100% solids content, Shore A Hardness 85 to 92, compatible with construction material placed against it. (USDA compliant, unless otherwise noted.)
 1. [MasterSeal CR 100](#), by Master Builders Solutions.

2.8 EXTERIOR PAVEMENT JOINT MATERIALS

- A. Joint Back-up Material: Polyethylene foam, 100% closed cell
- B. Sealant:
 1. Dow 888, by Dow Corning.
 2. 301 NS by Pecora.
 3. Spectrum 800 or 900 by Tremco.
- C. Preformed Expansion (Isolation) Joint Filler Strips (PMEJ): Flexible closed-cell non-extruding synthetic foam expansion joint strips.
 1. [Ceramar Flexibe Foam](#) Expansion Joint, by W.R. Meadows.
 2. [Deck-O-Foam](#) Expansion Joint Filler, by W.R. Meadows

2.9 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

2.10 SUBSTITUTIONS

- A. Comply with the requirements of Section 01600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and joint openings are ready to receive work and field measurements are as indicated on Drawings.
- B. Beginning of installation means installer accepts substrates.

3.2 EXTERIOR WALL JOINT PREPARATION

- A. Prepare exterior joints and install sealants in accordance with sealant manufacturer's recommendations:



English



Spanish

- B. Do not begin joint sealant work until wall painting work is complete. Sealed joints shall not be overcoated with paint.
- C. Clean and prime joints in accordance with manufacturer's instructions.
- D. Remove loose materials and foreign matter which might impair adhesion of sealant.
- E. Verify that new joint backing and release tapes are compatible with sealant.
- F. Protect elements surrounding work of this Section from damage or disfiguration
- G. Moving forward all joint sealant is to be installed after the painting is complete.

3.3 EXTERIOR WALL INSTALLATION

- A. Install new sealant in accordance with manufacturer's instructions.
- B. Measure joint dimensions and size materials to achieve required width/depth ratios.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond breaker where joint backing is not used.
- E. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Tool joints concave.

3.4 INTERIOR SLAB ON GRADE JOINT SEALING AND FILLING

- A. General:
1. Seal/fill contraction, isolation and construction joints in floor slabs and pavements, unless otherwise indicated on Drawings or specified herein.
 2. Unless noted otherwise, use polyurea joint filler in floor slab contraction and construction joints.
 3. Use elastomeric joint sealant in isolation joints and textured concrete joints.
 4. Use pavement sealant in pavement's contraction, construction, and isolation joints.
 5. Do not seal joints with materials specified herein when below relatively impervious floor finish material, such as PVC flooring, sheet rubber, wood, epoxy topping; refer to floor finish specification for joint sealing requirements.
 6. Do not place polyurea joint filler under resilient flooring or carpet. Reference Section 09650 or 09680 for joint subfloor filler materials and placement under floor covering.

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- B. Cleaning:
1. Immediately prior to sealing/filling, clean joints to full depth of sealant/filler in accordance with manufacturer's recommendation.
 2. Use vacuum with HEPA-rated filter to remove loose dirt, debris, saw laitance, and other foreign material from joint.
 3. Clean inner joint walls mechanically using one of the following HEPA-rated filter tools as recommended by the manufacturer for maintaining dust emissions below the permissible level
 - a. Humpback Dustless Joint Saw by Joe Due Blades & Equipment, www.joedue.com.
 - b. [Dust Buggy](#) by U.S. Saws, Santa Ana, CA (866) 987-7297.
 - c. [Gorilla Concrete Tools](#) GCT-10 or GCT-9 Silverback by OBHC, Inc., Columbia Station, OH, (440) 236-5112.
 4. Clean joint walls to the full depth of saw cuts and 2 inch minimum depth in construction joints that may not have been saw cut to create a support shelf.
 5. Remove form release agent, curing compound, or other components.
- C. General Installation:
1. Commence placing floor joint sealant / filler no sooner than 30 days after first placement of concrete.
 2. If joint is wet or damp, allow joint to dry for 72 hours prior to filling.
 3. Delay floor joint sealing / filling operations until facility's environmental systems have been placed in operation for 14 days.
 4. Mix and install sealant and filler in accordance with manufacturer's recommendations. Use primer if recommended for specific application.
 5. Choke off shrinkage crack if necessary at bottom of contraction joint or void below construction joints by the following methods.
 - a. Saw Cut Contraction Joints:
 - 1) Place 1/8 inch to 1/4 inch (maximum) layer of dry-bagged silica sand in joint to be epoxy filled. Do not use compressible backer rod. Use methods in handling sand to maintain dust emissions below the permissible level.
 - b. Construction Joints Through Slab: Fill by inserting compressible backer rod to a minimum depth of 2 inches below slab surface.
 6. Do not allow sealant / filler to extend over joint edges in finished condition.
- D. Elastomeric Joint Sealant Installation:
1. Use joint back-up material.
 2. Tool surface to provide smooth, attractive appearance and geometry recommended by sealant manufacturer.
- E. Joint Filler Installation
1. Cleaning: Immediately prior to filling, clean and prepare joint bottom and sidewalls as specified herein for general cleaning.
 2. Do not use joint back-up material (i.e. backer rod, sand, etc.) except below bottom of saw cut in construction joints. Provide a minimum joint filler depth of 2 inches.
 3. Install test sample of the polyurea joint filler to determine if filler will leave a stain, shadow, or film on slab surface.
 4. If test sample reveals stain, shadow, or film, use joint filler stain preventing film at joints to receive polyurea joint filler.
 5. Fill joint using single pass method. Fill joint full depth from bottom to top, leave slight crown at slab surface.
 6. Add extra filler prior to filler set if needed to prevent depressed areas. If concave filler is already set, abrade with wire wheel or similar tool to minimum depth of 1/4" below surface prior to refilling.
 7. Razor off crowned filler flush with floor surface after filler has sufficiently set.
 8. Remove stain preventing film (if used). Film shall be removed by joint filler installer immediately after shaving joint filler.
 9. One week prior to Grand Opening, refill joints if:
 - a. Joint filler sidewall separation or splitting exceeds 1/32 in.
 - b. Joint filler surface profile is concave, crowned, or chattered or if voids occur.
 10. Follow manufacturer's requirements for joint preparation for proper adhesion.
- F. Isolation Joints: Form isolation joints of preformed joint-filler strips (PMEJ) where indicated.
1. Extend joint fillers full width and depth of joint.
 2. Terminate joint filler or otherwise provide joint sealant cavity of not less than 1/2 inch or more than 1 inch

- below finished surface if joint sealant is indicated.
3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

3.5 EXTERIOR SIDEWALK AND PAVEMENT JOINT SEALING AND FILLING

- A. Fill and seal sidewalk and pavement joints in areas of pavement adjacent to the building. Joint filling and sealing of sidewalks and pavement not adjacent to building is specified in Division 2.
- B. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.
- C. Joint Sealants: Joints shall be sealed as shown and scheduled and shall be installed in accordance with manufacturer's recommendations.

3.6 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 SEALANT LOCATION SCHEDULE

- A. Provide sealants in accordance with the following schedule. Joint sealing required by the drawings or required for a complete and proper installation but not listed in the following schedule shall be sealed as necessary regardless of whether shown or scheduled. Such joints not shown or scheduled shall be sealed with sealants consistent with specified materials or as recommended by the manufacturer for the specific application.

EXTERIOR JOINTS				
	MATERIAL TO	MATERIAL	JOINT WIDTH	SEALANT TYPE
SITE	Concrete Sidewalk Control Joint	Concrete Sidewalk	1/4"	Sidewalks adjacent to building: See Materials Par. Otherwise: See Division 2.
	Concrete Sidewalk Expansion Joint at Building – PMEJ Joints Only	Concrete	1/2"	L2
	Concrete Paving Control Joint	Concrete Paving	1/4"	Pavement adjacent to building: See Materials Par. Otherwise: See Division 2.
	Concrete Paving Expansion Joint	Concrete	1/2"	See above
	Concrete Stair Expansion Joint	Concrete	1/2"	P1 or P3
	Concrete Curb Expansion Joint	Concrete	1/2"	See Division 2
	Metal Flashing	Metal Flashing		S1
	Metal Flashing	Aluminum Storefront Frame	1/4"	P1 or P3
SOFFITS	Gypsum Soffit Control Joint	Gypsum Soffit	3/8"	P1 or P3
	Gypsum Soffit Perimeter Expansion Joint	Concrete	3/8"	P1 or P3
	Metal Soffit Panel Trim	Concrete		P1 or P3
WALL PENETRATIONS	Aluminum Storefront Frame	Aluminum Storefront Frame	1/4"	P1 or P3
	Aluminum Storefront Sill	Cast Concrete Shapes or Concrete Slab	1/4"	P1 or P3
	Aluminum Storefront Door Threshold	Concrete Slab		P1 or P3
	Hollow Metal Door Frame	Concrete Wall, Tube Steel Frame	1/4"	P1 or P3
	Hollow Metal Door Threshold	Concrete Slab		P1 or P3
	Steel Corner Angle Frame	Concrete Wall	1/4"	P1 or P3
	Steel Pipe and/or Conduit Through	Concrete	1/2"	P1 or P3
	Ganged Steel Conduit Through	Concrete	1/2"	P1
	PVC and/or Copper Pipe Through	Concrete	1/2"	P1
	ROOF MEMBRANE AREA	Roofing Membrane	Roofing Membrane	
Roofing Membrane		Waterproof Wall Membrane		See Roofing Section
Roofing Membrane		Metal Facia		See Roofing Section
Roofing Membrane		Molded Pipe Flashing		See Roofing Section
Waterproof Membrane		Metal Facia, Plates, Bolts		P1 or P3
Waterproof Membrane		Steel Conduit	1/2"	P1 or P3
Metal Cap Flashing Joint		Metal Cap Flashing	1/8"	S1
Metal Cap Flashing Expansion Joint		Metal Cap Flashing	1"	S1
Metal Cap Flashing		Gasketed Fasteners		S1

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EXTERIOR JOINTS					
	MATERIAL	TO	MATERIAL	JOINT WIDTH	SEALANT TYPE
	Skylight Flashing Joints		Skylight Flashing		S1
	Vent Flashing Joints		Vent Flashing		S1
	Smoke Vent Flashing Joints		Smoke Vent Flashing		S1
	RTU Flashing Joints		RTU Flashing		S1
	Waterproof Membrane Termination Bar		Concrete Wall	1/4"	P1
	Steel Gutter		Steel Gutter or Downspout		S1
	Steel Downspout		Steel Downspout		S1
	Urethane Rubber Seal System		Steel Pipe/ Flue	Varies	See Section 07530
	PVC Sleeve		Sheet Metal Hood/Closure Plate		S1
	Conduit		Sheet Metal Hood/Closure Plate		S1
ROOF METAL/ FIBERGLASS PANELS	Roof Panel		Flue Penetration Flashing		P1 or P3
	Roof Panel		Gutter		P1 or P3
	Roof Panel		End Closure		P1 or P3

INTERIOR JOINTS					
	MATERIAL	TO	MATERIAL	JOINT WIDTH	SEALANT TYPE
FLOOR	Concrete Floor		Concrete Floor		
	Contraction and Construction Joint			1/4"	See Materials Par.
	Expansion Joint			3/4"	Same
	Isolation Joint			See Dwgs	Same
	Concrete Curb In Grocery		Concrete Floor		Same
	Ceramic Tile Expansion Joints		Ceramic Tile	Ref Mfr.	P1 or P3
	Mop Sink		Floor		P1 or P3
Structural Steel Column		VCT/PVC		P1	
WALLS	Concrete Wall Control Joint, 3/8"		Concrete Wall	3/8"	P1
	Concrete Wall Expansion Joint, 1"		Concrete Wall	1"	P1
	Rated Gypsum Board Wall Control Joint		Rated Gypsum Board Wall		
	Rated Gypsum Board Wall		Metal Roof Deck or Rated Concrete Wall		See Section 07840 - Firestopping
	Gypsum Board		Concrete Walls	3/8"	P1 (Use edge trim, ref. Section 09250)
	Ceramic Tile		Wood or Galvanized Steel Base Trim		P1 or P3
	Ceramic Tile		Stainless Steel		S1 or S2
	Ceramic Tile		Ceramic Tile		P1 or P3
Plastic Base		Concrete		P1 or P3	

INTERIOR JOINTS						
	MATERIAL	TO	MATERIAL	JOINT WIDTH	SEALANT TYPE	
	Joints shown on the drawings to be sealed with Expanding Foam Sealant				EF1	
WALL PENETRATIONS	Aluminum Storefront Frame		Alum Storefront Frame, Concrete, or Gypsum Board	1/4"	P1	
	Aluminum Storefront Sill		Gypsum Board Wall or Cast Concrete Shapes	1/4"	P1	
	Hollow Metal Door Frame		Concrete or Gypsum Board	1/4"	P1	
	Steel Corner Angle Frame		Concrete Wall	1/4"	P1	
	Steel Pipe or Conduit Through		Concrete Wall	1/2"	P1	
	Steel Pipe or Conduit Through		Gypsum Board	1/4"	P1	
	PVC or Copper Pipe Through		Concrete or Gypsum Board	1/2"	P1	
	Steel, PVC, or Copper Pipe Through		Rated Concrete or Gypsum Board Wall		See Section 07840	
	Steel Conduit Through		Rated Concrete or Gypsum Board Wall		See Section 07840	
	TOILET	Sink		Ceramic Tile Wall		S2
	FIXTURES	Floor Mount Toilet		Ceramic Tile Floor		S2
		Wall Mount Toilet or Urinal		Ceramic Tile Wall		S2
EWC	Electric Water Coolers		Ceramic Tile		P1 or P3	
COUNTER	Plastic Laminate Counter Tops		Gypsum Board or Plastic Laminate Walls		S2	

END OF SECTION

SECTION 07950 (07 9500) - EXPANSION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exterior wall expansion control systems.
 - 2. Exterior roof expansion control systems.
 - 3. Exterior floor expansion control systems.
 - 4. Interior wall expansion control systems.
 - 5. Interior floor expansion control systems.

1.02 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.
- B. Samples for Initial Selection: For each type of expansion control system indicated.
 - 1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Materials to be supplied by Inpro Corporation 'JointMaster' Regional Sales Manager, Justin Lofting, Mobile (760) 207-7666, jlofting@inprocorp.com, www.inprocorp.com. No substitutions allowed.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

2.02 SYSTEM DESCRIPTION+

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
 - 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
 - 3. Frames for Strip Seals: Designed with semi-closed cavity that provides a mechanical lock for seals of type indicated.
- B. Nominal Joint Width: As indicated on drawings.

- C. Coordination: Coordinate installation of exterior wall expansion control systems with roof expansion control systems to ensure that wall transitions are watertight.

2.03 MATERIALS

- A. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- B. Aluminum Extrusions: ASTM B221; Standard specifications for aluminum and aluminum-alloy extrusions.
- C. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.04 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 PERFORMANCE REQUIREMENTS

- A. Insulated Vapor Barrier, ASTM test reports created by a certified third party. Architectural product testing agency.
 - 1. ASTM C1363 Thermal Performance Test
 - 2. ASTM E283 Pressure Test for Rate of Air
 - 3. ASTM E330 Dynamic Structural Performance
 - 4. ASTM E331 Static Water Penetration Test
- B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."

2.06 EXTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product (Building Shell Roof Applications): Subject to compliance with requirements, provide expansion joint by Inpro:
 - 1. Inpro: Models 651-A01 **EJ-10** & 651-A02 **EJ-11** with insulated vapor barrier.
 - a. Roof to Roof and Roof to Wall applications at building shell roof.
 - 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 18 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - 3. Type: Raised cover plate, continuous.
 - a. Cover-Plate Design: Thermal & Seismic
 - 1) Cant strip mounted, Self-Flashing base members.

- b. Metal: Aluminum.
 - 1) Finish: Mill.
 - 4. Accessories:
 - a. JL Series continuous Insulated Moisture Barrier.
- B. Basis-of-Design Product (Exterior Wall Applications): Subject to compliance with requirements, provide expansion joint by Inpro:
 - 1. Inpro: Model 612-A07/A09 **EJ-20** with insulated vapor barrier.
 - a. Wall to Wall applications at building shell and stair towers.
 - 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 18 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - 3. Type: Santoprene Face Seal
 - a. Cover-Plate Design: Flexible
 - 1) Flush Mounted: Provide flush joint surface with adjacent wall.
 - b. Metal: Aluminum.
 - 1) Finish: Mill
 - c. Santoprene Face Seal
 - 1) Finish: To be selected from manufactures standards
 - 4. Accessories:
 - a. JL Series continuous Insulated Moisture Barrier.
- C. Basis-of-Design Product (Exterior Wall Applications): Subject to compliance with requirements, provide expansion joint by Inpro:
 - 1. Inpro: Model 491E **EJ-25** with insulated vapor barrier.
 - a. Wall to Wall applications at building shell and stair towers.
 - 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 5 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - 3. Type: Santoprene Face Seal
 - a. Cover-Plate Design: Flexible
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- 1) Flush Mounted: Provide flush joint surface with adjacent wall.
 - b. Metal: Aluminum.
 - 1) Finish: Mill
 - c. Santoprene Face Seal
 - 1) Finish: To be selected from manufactures standards
 - 4. Accessories:
 - a. JL Series continuous Insulated Moisture Barrier.
- D. Basis-of-Design Product (Exterior Pedestrian Foot Traffic) Subject to compliance with requirements, provide expansion joint by Inpro:
- 1. Inpro: Model 806-A01/A02 **EJ-30**.
 - a. Floor to Floor and Floor to Wall applications at elevated walkway.
 - 2. Design Criteria:
 - a. ADA compliant
 - b. Nominal Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: 12 inches.
 - d. Movement Capability: As indicated on structural drawings.
 - e. Type of Movement: Thermal and seismic.
 - f. Load Capacity:
 - 1) Uniform Load: 150 lb/sq. ft.
 - 2) Concentrated Load: 2000 lb.
 - 3) Maximum Deflection: 0.25 inch.
 - 3. Type: Cover plate, surface mounted.
 - a. Cover-Plate Design: Thermal & Seismic.
 - 1) Surface Mounted: Provide walking surface.
 - b. Metal: Aluminum.
 - 1) Finish: Mill
 - 4. Accessories:
 - a. JL Series continuous Reinforced Moisture Barrier

2.07 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product (Material Handling Industrial Traffic): Subject to compliance with requirements, provide expansion joint by Inpro:
 - 1. Inpro: Model 797-G01 **EJ-35**
 - a. Floor to Floor applications at level 2 and level 3.

2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 14 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - e. Load Capacity:
 - 1) Uniform Load: 250 lb/sq. ft.
 - 2) Concentrated Load: 3000 lb.
 - 3) Maximum Deflection: 0.25 inch.
 - f. Provide Finite Element Analysis Report for expansion joint cover materials and loading criteria of facility specific material handling industrial traffic.
 3. Type: Cover plate, recessed
 - a. Cover-Plate Design: Crowned separation cover with durometer sound and vibration dampening support
 - 1) Cover-Plate Recess Depth: As required to provide flush transition surface. Review Architectural and Structural plans for specific block-out dimensions and requirements.
 - b. Metal: Galvanized Steel.
 - 1) Finish: Galvanized
- B. Basis-of-Design Product (Pedestrian Traffic at Office): Subject to compliance with requirements, provide expansion joint by Inpro:
1. Inpro: Model 806SD-A01 **EJ-30** with reinforced vapor barrier as indicated on drawings.
 - a. Floor to Floor applications at level 2.
 2. Design Criteria:
 - a. ADA compliant.
 - b. Nominal Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: 9 inches.
 - d. Movement Capability: As indicated on structural drawings.
 - e. Type of Movement: Thermal and seismic.
 - f. Load Capacity:
 - 1) Uniform Load: 150 lb/sq. ft.
 - 2) Concentrated Load: 2000 lb.
 - 3) Maximum Deflection: 0.25 inch.
 3. Type: Cover plate, surface mount.
 - a. Cover-Plate Design: Plain.
 - 1) Surface Mounted: Provide walking surface.
 - b. Metal: Aluminum
 - 1) Finish: Mill

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- C. Basis-of-Design Product (Pedestrian Traffic at Shafts): Subject to compliance with requirements, provide expansion joint by Inpro:
1. Inpro: Model 806SD-A01/A02 **EJ-30** with reinforced vapor barrier as indicated on drawings.
 - a. Floor to Floor and Floor to Wall applications at level 2 and level 3.
 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 11 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - e. Load Capacity:
 - 1) Uniform Load: 150 lb/sq. ft.
 - 2) Concentrated Load: 2000 lb.
 - 3) Maximum Deflection: 0.25 inch.
 3. Type: Cover plate, surface mounted.
 - a. Cover-Plate Design: Plain.
 - 1) Surface Mounted: Provide walking surface.
 - b. Metal: Aluminum.
 - 1) Finish: Mill
- D. Basis-of-Design Product (Interior Wall Expansion Joint): Subject to compliance with requirements, provide expansion joint by Inpro:
1. Inpro: Model 355-A07 **EJ-50**
 - a. Wall to Wall applications - High Finish Office Areas
 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 14 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 3. Type: Cover plate, flush mounted
 - a. Cover-Plate Design: Elastomeric Santoprene seal set in Aluminum Extrusion
 - b. Color: To be selected from manufactures standard
- E. Basis-of-Design Product (Interior Wall Expansion Joint): Subject to compliance with requirements, provide expansion joint by Inpro:
1. Inpro: Model 612-A07 **EJ-51**
 - a. Wall to Wall applications – Warehouse
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- b. Finish Floor to 8ft above Finish Floor.
 - 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 18 inches.
 - c. Movement Capability: As indicated on structural drawings.
 - d. Type of Movement: Thermal and seismic.
 - 3. Type: Santoprene Face Seal
 - a. Cover-Plate Design: Flexible
 - 1) Flush Mounted: Provide flush joint surface with adjacent wall.
 - b. Metal: Aluminum.
 - 1) Finish: Mill
 - c. Santoprene Face Seal
 - 1) Finish: To be selected from manufactures standards
- F. Basis-of-Design Product (Wall & Ceilings at Office): Subject to compliance with requirements, provide expansion joint by Inpro:
 - 1. Inpro: Model 353C-A24 **EJ-60**
 - a. Ceiling to Ceiling applications - High Finish Office Areas
 - 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Maximum Joint Width: 14 inches.
 - c. Type of Movement: Thermal and seismic.
 - 3. Type: Recessed Infill Pan system
 - a. Cover Plate Design: Infillable coverplate pan to be installed using magnetic security system
 - b. Color: mill finish

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.

- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.03 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- C. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer before installing compression seals.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- E. Provide continuous and sealed Insulated Vapor Barrier at all exterior expansion joint assemblies as per manufacture installation instructions to maintain ASTM tested assembly as specified.

3.04 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel doors, panels, and frames.
 - 2. Glazed light frames.
- B. Related Sections:
 - 1. Section 01600 – Product Requirements: Contractor’s Products Selection checklist.
 - 2. Section 08710 - Door Hardware: Door hardware coordination.
 - 3. Section 08800 - Glazing: Glass in steel doors and frames.
 - 4. Section 09250 - Gypsum Board: Door frame attachment to metal wall framing.
 - 5. Section 09900 - Paints and Coatings: Field painting of doors and frames.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
 - 2. ANSI A250.8 (Formerly SDI-100) - Recommended Specifications for Standard Steel Doors and Frames.
 - 3. ANSI A250.11 (Formerly SDI-105) - Recommended Erection Instructions for Steel Frames.
- C. ASTM International (ASTM):
 - 1. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - 2. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 DELIVERY, STORAGE AND PROTECTION

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Receive and accept products and report suspected defects and shipping discrepancies in compliance with the requirements of Section 01600.
- C. Product Packaging: Doors will be shipped in manufacturer's standard packaging with identification markings on each component or package.
- D. Product Compliance Inspection: Inspect delivered products for compliance with product descriptions in Part 2 herein. Report discrepancies to the Architect.
- E. Protect doors and frames with resilient packaging. Break seal on-site to permit ventilation.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify that field measurements are as indicated on shop drawings.
- B. Coordination: Coordinate the work with door opening construction, door frame and door hardware installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Doors and Frames: Subject to compliance with requirements specified herein, provide flush doors and frames by one of the following:
1. Amweld Building Products Division.
 2. [Ceco Door \(an Assa Abloy Company\)](#).
 3. [Curries \(an Assa Abloy Company\)](#).
 4. [Deansteel](#).
 5. [Door Components Inc \(DCI\)](#).
 6. [Hollow Metal Express \(HMX\)](#).
 7. [Mesker](#).
 8. [Metal Products Inc \(MPI\)](#).
 9. [Pioneer Industries \(an Assa Abloy Company\)](#).
 10. [Premier](#).
 11. [Republic](#).
 12. [Security Metal Products \(SMP\) \(an Assa Abloy Company\)](#).
 13. [Steelcraft \(an Allegion Company\)](#).
- B. Provide products by the manufacturers listed herein. No substitutions allowed.

2.2 SUPPLIERS

- A. Provide door hardware from one of the national or local suppliers.
1. [DH Pace, Inc.](#), Springfield, MO, Mark Lyons, (417) 831-5585, walmartdoors@dhpaces.com.
 2. [Trudoor](#), (844) 878-3667.
 3. [AB Supply \(Architectural Building\)](#), (844) 809-3667.
 4. [Felix Thompson Company](#) (AR, OK), (479) 646-7321.
 5. [CDF Distributors](#), (855) 769-9895.
 6. [Doormart USA](#), (877) 561-3667.
 7. [DKS Doors](#), (817) 275-3070.
 8. [The Hallgren Company](#), (806) 798-3999.
 9. This list of suppliers is not exhaustive. Contact manufacturers for additional authorized local or national suppliers not listed.

2.3 DOORS

- A. Interior Doors: ANSI 250.8, Level 1 and Physical Performance Level C (Standard-Duty), 1-3/4 inches thick, Model 1 (Full Flush) 0.032 min. thickness (20 gage), cold-rolled steel, optional core construction as specified below.
- B. Exterior Doors: ANSI 250.11, Level 2 and Physical Performance Level B (Heavy Duty), 1-3/4 inches thick, Model 1 (Full Flush) 0.042 inch min. thickness (18 gage), ASTM A 653, Commercial Steel (CS), Type B, with an A60 zinc-iron-alloy (galvannealed) coating cold-rolled steel, polyurethane or polystyrene foam insulated core construction
1. Fabricate head flush with top edge to exclude water.
- C. Core Construction:
1. Polyurethane core foamed in place or laminated, R=10; 1/2 inch maximum voids in any direction. Strength of bond between core and steel face sheet shall exceed strength of core so delamination will not occur during operating conditions.
 2. Rigid core of polystyrene foam board, R=7. Strength of bond between core and steel face sheet shall exceed strength of core so that delamination will not occur under operating conditions.
 3. Honeycomb Core: Kraft fiber honeycomb with nominal 1 inch cell size and crush strength of 45 psi.
 4. If laminated insulation is used, apply adhesive full coverage to door face.

2.4 FRAMES

- A. Interior Drywall Frames: 0.053 min. thickness (16 gage), cold-rolled steel, mitered welded units.
 - 1. Jamb depth: Sized to fit wall thickness.
- B. Exterior Frames: (16 gage steel), A60 galvanized coating (ASTM A 653), mitered and welded units.
 - 1. Jamb depth: 5-3/4", unless otherwise indicated on Drawings.

2.5 ACCESSORIES

- A. Rubber Silencers: Resilient rubber. Specified in Section 08710.
- B. Glazing Stops: Rolled steel channel shape, butted corners. Prepare for countersink style screws, located no more than 2 inches from each end, and spaced no more than 12 inches on center.
- C. Mullions For Double Doors: Removable type, specified in Section 08710.
- D. Astragals for Double Doors: Steel, specifically for double doors. For rated pairs of doors, provide astragal to meet UL rating requirement. If doors are provided that maintain rating without an astragal, submit door manufacturer's literature indicating UL rating. If U-shaped astragal is used that does not require a coordinator, omit double door coordinator from applicable hardware set in Section 08710.
- E. Board Insulation Blocking: ASTM C578, Type IV (density 1.6 pcf minimum), 1 inch thick. Provide one of the following:
 - 1. Greenguard CM by Pactiv Building Products, Smyrna, GA (800) 241-4402.
 - 2. Styrofoam Square, by Dow Chemical Co., Midland, MI (800) 232-2436.
 - 3. Foamular 250, by Owens Corning, Toledo, OH (800) 438-7465.

2.6 PROTECTIVE COATINGS

- A. Bituminous Coating: Fibered asphalt emulsion, field applied.
- B. Primer: Exposed surfaces shall be cleaned, treated with Bonderite chemical and given one baked-on shop coat of gray synthetic primer.

2.7 FABRICATION

- A. Fabricate doors and frames in accordance with ANSI A250.8.
- B. Fabricate doors with hardware reinforcement welded in place.
- C. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. For welded frames, weld face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
- F. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- G. Silencers: Prepare frames for silencers.
 - 1. Single Doors: Provide 3 single rubber silencers on strike side.
 - 2. Double Doors with Mullions: Provide 3 single rubber silencers on each door, on strike side.
 - 3. Double Doors Without Mullions: Provide 2 single silencers on frame head.
 - 4. Do not install silencers until frames have received their final finish coat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate conditions, opening sizes and tolerances are acceptable for proper installation.

3.2 INSTALLATION

- A. Install frames in accordance with ANSI A250.11.
- B. Install doors in accordance with ANSI A250.8.
- C. Coordinate with adjacent wall construction for anchor placement.
- D. Coordinate installation of glass and glazing.
- E. Coordinate installation of doors with installation of hardware specified in Section 08710.
- F. Provide board insulation blocking at exterior hollow metal frames. Glue blocking in frame jambs (strike side and hinge side) at height indicated on Drawings.

3.3 ADJUSTING AND CLEANING

- A. Test for smooth operation through full range of swing; make necessary adjustments.
- B. Coordinate adjustment of doors with installation of hardware. Adjust doors and hardware for smooth and balanced door movement. Comply with ANSI A117.1.

END OF SECTION

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-rated and non-rated access doors and frames for walls and ceilings.
- B. Related Sections:
 - 1. Section 09250 - Gypsum Board: Openings in gypsum board ceilings.
 - 2. Section 09900 - Paints and Coatings: Field paint finish.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 879 - Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - 3. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 80 - Fire Doors and Windows.
 - 2. NFPA 252 - Fire Tests for Door Assemblies.
- D. Underwriters Laboratories (UL):
 - 1. UL 10B - Fire Tests of Door Assemblies.
 - 2. UL 263 - Fire Tests Of Building Construction And Materials.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with UL requirements.
- B. Fire-Rated Access Doors and Frames: Provide units complying with NFPA 80 that are identical to assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.
 - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide access doors by one of the following manufacturers:
 - 1. Milcor, Inc (Commercial Products Group) Bensenville, IL; Contact Don Fessendon (630) 595-7320.
 - 2. Acudor Products, Inc., Fairfield, NJ. (800) 722-0501.
 - 3. Nystrom Building Products, Minneapolis, MN. (800) 547-2635 or (612) 781-7850.

2.2 STEEL MATERIALS

- A. Steel Sheet: Uncoated or electrolytic zinc-coated, ASTM A 879 with cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.
- B. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS) with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating.
- C. Drywall Beads: 0.0299-inch zinc-coated steel sheet to receive joint compound.
- D. Manufacturer's standard finish factory primed finish.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Flush Access Doors and Frames:
 - 1. Fabricated from steel sheet
 - 2. Exposed Trim Type:
 - a. Model NT by Nystrom.
 - b. Model M 3202 by Milcor.
 - c. Model UF 5000 by Acudor.
 - 3. Trimless Frame:
 - a. Model MW by Nystrom.
 - b. Model DW 3203 by Milcor.
 - c. Model DW 5040 by Acudor.
 - 4. Locations: Wall and ceiling.
 - 5. Door: Minimum 0.060-inch- thick sheet metal.
 - 6. Frame: Minimum 0.060-inch- thick sheet metal with 1-1/4-inch- wide, surface-mounted trim.
 - 7. Hinges: Spring-loaded, concealed-pin type or continuous piano.
 - 8. Latch: Cam latch with interior release. Provide latch for all units unless specified to have locks.
 - 9. Lock: Cylinder with 2 keys. Provide lockable cylinders as follows:
 - a. Exterior locations.
 - 10. Units larger than 24 inches on the hinge side shall have two locks or latches.
- B. Fire-rated, Insulated, Flush Access Doors and Frames:
 - 1. Fabricated from steel sheet
 - 2. Exposed Trim or Trimless Type:
 - a. Model IT or IW by Nystrom
 - b. Model UFR 3218 by Milcor.
 - c. Model FW 5050 by Acudor.
 - 3. Locations: Wall and ceiling surfaces.
 - 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 5. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 - 6. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 - 7. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.
 - 8. Hinges: Concealed-pin type or continuous piano.
 - 9. Automatic Closer: Spring type.
 - 10. Latch: Self-latching device operated with interior release.
 - 11. Size: Minimum 24 x 36 inches except where otherwise shown on the drawings.
- C. Substitutions: Not Permitted.

2.4 FINISH

- A. Base Metal Protection: Factory prime coat units with electrostatic baked on electrostatic powder. For ceiling units, prime exposed edges with coat of white rust-inhibitive paint.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify rough openings for door and frame are correctly sized and located.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install units plumb, square and flush with adjacent ceiling or wall surface. Secure rigidly in place.
- C. Position to provide convenient access to concealed work requiring access.
- D. Provide weather tight installation at exterior locations

3.3 ACCESS DOOR SCHEDULE

- A. Provide access door and frame suitable for the application.
- B. Install trimless access door and frame in interior gypsum board walls and ceilings and other locations suitable and adaptable for trimless installation
- C. Install exposed trim access door and frame where at exterior locations and where impractical to install trimless installation.
- D. Install access doors in ceilings and walls in locations as shown on the Drawings, at valves, controls, and manual dampers requiring access, and as required by code and governing authorities.
- E. For access doors adjacent to secure areas, coordinate location with Owner's Construction Manager.

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END OF SECTION

08311-4

SECTION 08335 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Exterior, non-fire rated overhead coiling doors.
- B. Related Requirements:
 - 1. Section 05500 - Metal Fabrications: Miscellaneous concealed structural support for overhead coiling door.
 - 2. Section 07840 - Firestopping: Installation of perimeter and penetration firestopping.
 - 3. Section 07900 - Joint Sealants: Installation of sealant at visible joints around frames and tracks.
 - 4. Section 09900 - Paints and Coatings: Application of field paint finish.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. National Fire Protection Association (NFPA)
 - 1. NFPA 80 - Standard for Fire Doors and Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies
- C. UL - Underwriters Laboratories, Inc.
 - 1. 10b – Fire Test of Door Assemblies

1.3 DELIVERY, STORAGE AND HANDLING

- A. Product Delivery: Deliver products to jobsite to be received by the Contractor. coordinate product delivery and installation. in compliance with the owner products delivery requirements of Section 01600.
- B. Product Packaging: Deliver Overhead coiling doors in manufacturer's standard packaging with identification markings on each component or package.
- C. Receive and accept owner furnished products and report suspected defects or discrepancies in compliance with the requirements of Section 01600.
- D. Handle, store, and protect products in accordance with Section 01600.

PART 2 - PRODUCTS

2.1 OVERHEAD COILING DOORS

- A. [Overhead Door Corporation](#), Dallas, TX. National Account Sales Manager: John Blaskovich (800) 972-1730.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Overhead Coiling Doors: Doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
 - 1. Design doors to sustain wind load pressures shown on the drawings as calculated by the manufacturer in accordance with ASCE/SEI 7. (See Structural Drawing Sheet S0) Exterior coiling doors shall withstand the effects of gravity loads, and the loads and stresses within limits and under conditions, locations, and door sizes indicated when tested in accordance with ASTM E 330 or DASMA 108.

2. Design doors to withstand design wind loads without evidencing deformation or disengagement of door components, shall remain in the opening throughout the duration of the test, and shall be deemed fully operable at the conclusion of the test in accordance with test standards specified above.

2.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be by a manufacturer's authorized representative or distributor who is trained and approved for both installation and maintenance of units required for this Project.

2.4 DESCRIPTION

- A. Provide the door models specified below as applicable and as shown on the drawings. Provide manufacturer's standard components except as otherwise specified.
- B. Exterior Insulated Door: Model: Series 625, Stormtite.
 1. Components:
 - a. Curtain: Flat profile, insulated, roll-formed, 24 gage galvanized slats.
 - b. Electric Motor Operation (where indicated on Drawings): Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot or more than 1 foot per second.
 - 1) Sensing Edge Protection: Electric sensing edge.
 - 2) Operator Controls: Push-button and key operated control stations with open, close, and stop buttons for surface mounting, for interior location.
 - c. Wall Mounting Condition: Face-of-wall mounting.
 2. Finish:
 - a. Galvanized Steel:
 - 1) Primer: 0.2 mils thick baked-on rust-inhibitive primer, roll coating process.
 - 2) Finish Coat: Factory applied 0.6 mils thick baked-on polyester powder coated top coat.
 3. Color: Factory White unless otherwise as shown on Drawings.

2.5 EXAMINATION

- A. Examine surfaces and adjacent areas. Do not proceed with Work until unsatisfactory conditions have been corrected.
 1. Openings shall be to the dimensions indicated.
 2. Headers shall be level and parallel with finish floor.
 3. Door support framing installed at locations indicated.

2.6 PREPARATION

- A. Interface with Other Work.
 1. Coordinate construction of door openings within fire rated partition. Ensure that door head is constructed parallel to floor.
 2. Coordinate installation and locations of structural supports for door assembly.

2.7 FIELD QUALITY CONTROL

- A. Site Tests: Upon completion of installation, test operation of door.
 1. Make all necessary adjustments as required and retest.
 2. After acceptance of test results, re-set door to original position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors in accordance with manufacturer's published instructions.

- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- D. Install chain keeper at each door in accordance with manufacturer's instructions.

3.2 CONTRACTOR RESPONSIBILITY

- A. Provide openings, size as scheduled on Drawings, with head, jambs, and sill as detailed.
- B. Contractor shall field paint visible surfaces of curtain guides and framing when door is in open position as specified in Section 09900.
- C. Install metal fabrications for support and attachment of door assembly. Door structural supports shall be as specified in Section 05500.
- D. Provide sealants and backing materials at frame perimeter as specified in Section 07900.

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END OF SECTION

08335-4

SECTION 08360 - SECTIONAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes
 - 1. Manually operated sectional doors.
 - 2. Electrically operated sectional doors.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Flat door sections with attached perimeter gasket.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. General: Provide each sectional door as a complete unit produced by one manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators and installation accessories, to suit openings and head room allowable.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

1.06 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Wind Loading: Design and reinforce sectional doors to withstand wind loading pressures indicated on structural drawings and as required by local jurisdictions having authority on over the project.
 - 2. Testing: According to ASTM E 330.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - 4. Operability under Wind Load: Design sectional doors to remain operable under design wind load, acting inward and outward.

- C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Environmental Standards: Coating materials shall comply with provisions of the following:
 - 1. Environmental Protection Agency (EPA) National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings, unless more stringent standards are required by authorities having jurisdiction.
- E. Environmental Standards: Plastic foam insulation shall comply with provisions of the following:
 - 1. United National Environmental Program (UNEP) and Environmental Protection Agency (EPA) requirements on the elimination of chlorofluorocarbons (CFC's) blowing agent.
 - 2. Only plastic foam insulation using alternative blowing agent complying with Environmental Protection Agency (EPA) requirements on Volatile Organic Compounds (VOC) shall be used; unless the manufacturer is exempt.

2.03 DOOR ASSEMBLY

- A. Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
 - 1. Basis of Design: 4 Front Engineered Solutions, TKO CruiserWeight or WelterWeight as required to meet structural requirements.
 - 2. Approved Alternate: DL Manufacturing, PxV or MxV Energy-Absorbing Door as required to meet structural requirements.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
- D. Steel Sections: Zinc-coated (galvanized) steel sheet with G90 (Z275) zinc coating.
 - 1. Section Thickness: 1.75 inches (44 mm) minimum.
 - 2. Exterior-Face, Steel Sheet Thickness: 0.040-inch- (1.02-mm-) 20 gage, minimum, nominal coated thickness.
 - a. Surface: Flat.
 - 3. Insulation: Foamed in place.
 - 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of manufacturer's recommended dimension to comply with performance requirements.
- E. Track Configuration: Vertical-lift track.
- F. Weatherseals: Fitted to bottom and top and around entire perimeter of door.
- G. Windows: Approximately 6 by 20 inches and spaced apart the approximate distance as indicated on Drawings; in one row(s) at height indicated on Drawings; installed with glazing of the following type:

1. Clear Polycarbonate Plastic: 3-mm-thick, transparent, fire-retardant, UV-resistant, polycarbonate sheet manufactured by extrusion process.
 2. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors, as required. Provide removable stops of same material as door-section frames.
 3. Window location to be coordinated on the side of door for visibility to outside trailers from the inside dock equipment control mounting location.
- H. Roller-Tire Material: Case-hardened steel.
- I. Locking Devices: Equip door with slide bolt for padlock.
1. Locking Device Assembly: Single-jamb side locking bars, operable from.
- J. Counterbalance Type: Weight counterbalance.
- K. Manual Door Operator: Push-up operation.
- L. Door Finish:
1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's full range.
 2. Factory Prime Finish: Manufacturer's standard color.
 3. Finish of Interior Facing Material: Match finish of exterior section face.

2.04 POLYMER DOOR SECTIONS

- A. Exterior Section Faces and Frames: UV inhibited, weather resistant PVC. Insulation closed cell polyurethane r-16 (minimum). End cap injection molded plastic.
1. Fabricate section faces from single sheets to provide sections not more than 24 inches (610 mm) high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- (1.63-mm-) nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch- (1.63-mm-) thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches (1219 mm) apart.
- C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.
- D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
- E. Provide reinforcement for hardware attachment.
- F. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. En-

close insulation completely within steel sections and the interior facing material, with no exposed insulation.

- G. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.05 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel or synthetic track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
 - 1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 (Z180) zinc coating.
 - 2. Slot vertical sections of track at 2 inches o.c. for door drop safety device.
 - 3. Weld or bolt to track supports.
 - 4. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 - 5. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.
 - a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
 - b. Provide Anti-drift Down Lock to hold door full opened without the ability to drift down.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.
 - 1. Provide full perimeter combination bush/seal kit at jambs and head for a fully weather-tight installation.
 - 2. Provide manufacturers standard bottom brush kit to seal the door tightly to the floor

2.06 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

1. Case-hardened steel tires, for normal installations.
- D. Push/Pull Handles: Equip each push-up operated door with galvanized-steel lifting handles on each side of door.
1. Color: As selected by Architect.
 2. Quantity: Two.

2.07 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, unless otherwise required to achieve wind loading requirements, located on single-jamb side, operable from inside only.

2.08 COUNTERBALANCE MECHANISM

- A. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a PVC pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.
- B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.
- C. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 7 to 1.
- D. Cable Safety(Cable Break) Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.09 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.

2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
1. Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right side of door and connected to torsion shaft with an adjustable coupling or drive chain.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 11 05 13 "Common Motor Requirements for Equipment" unless otherwise indicated.
1. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding name-plate ratings or service factor.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Remote-Control Station: Continuous-contact for down only, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Provide second remote control unit located as directed by owner in Area 100 office.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install to provide weather tight installation. Daylight not to be visible through the exterior envelope from inside the building.
- C. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.

- D. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.03 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning equipment.

3.04 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

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SECTION 08411 - ALUMINUM FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum glazed framing systems.
- B. Related Sections:
 - 1. Section 01600 – Product Requirements: Contractor’s Products Selection checklist.
 - 2. Section 08462 - Automatic Sliding Entrance Doors: Coordination between components.
 - 3. Section 08800 - Glazing: Glass products.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Architectural Aluminum Manufacturers Association (AAMA):
 - 1. AAMA 611 – Voluntary Specifications for Anodized Architectural Aluminum.
- C. ASTM International (ASTM):
 - 1. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings On Iron And Steel Products
 - 2. ASTM E 283 - Standard Test Method For Determining Rate Of Air Leakage Through Exterior Windows, Curtain Walls, And Doors Under Specified Pressure Differences Across The Specimen
 - 3. ASTM E331 - Water Penetration Of Exterior Windows, Skylights, Doors, And Curtain Walls By Uniform Static Air Pressure Difference
 - 4. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 - 5. ASTM E 1996 - Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- D. Americans with Disabilities Act (ADA), ADA-ADAAGS - 2010 ADA Standards for Accessible Design.
- E. American National Standards Institute (ANSI):
 - 1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

1.3 SYSTEMS DESCRIPTION

- A. Storefront System Performance Requirements:
 - 1. Air Infiltration: ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft² at a static air pressure differential of 6.24 psf.
 - 2. Water Penetration Under Static Pressure: Systems do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbs/sq. ft.
 - 3. Structural Performance: Maximum deflection of L/175 of span under a windload pressure calculation by the manufacturer based on the design wind loads shown on the Structural Drawings but not less than 20 psf.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: [Kawneer Company, Inc.](#), National Accounts Contacts as follows:
 - a. Eastern Area: Bloomsburg, PA, (570) 784-8000 or Harrisonburg, VA, (540) 433-2711.
 - b. Southern/Central Area: Springdale, AR, (479) 756-2740.
 - c. Western Area: Visalia, CA, (559) 651-4000.
- B. Kawneer product designations are used within this Section to identify aluminum framed storefront types and associated products unless noted otherwise.
- C. Alternate Manufacturers: Subject to compliance with project requirements, equivalent storefront and accessories by the following manufacturers may be provided:
 - 1. [EFCO Corporation](#); Monett, MO; (800) 221-4169.
 - 2. [Tubelite, Inc.](#); Reed City, MI; (800) 866-2227.
 - 3. [Oldcastle Building Envelope](#).(Vistawall), Santa Monica, CA, (866) 653-2278.
- D. Provide products by the manufacturers listed herein. No substitutions allowed.

2.2 SUPPLIERS

- A. Storefront suppliers may be identified by selecting the following links to view distribution maps or by contacting the manufacturers directly:
 - 1. [Kawneer](#): Distributed from multiple proprietary service centers.
 - 2. [EFCO](#): Distributed from multiple independent distribution centers.
 - 3. [Tubelite](#): Distributed from multiple nationwide independent distributors.
 - 4. [Oldcastle](#): Distributed from one of 78 proprietary distribution centers among 23 states.

2.3 FRAMING

- A. Interior Framing System: TRIFAB VG 450, by Kawneer. 1-3/4 x 4-1/2 inch nominal dimension, extruded aluminum flush glazed framing system for un-insulated glazing systems.
- B. Exterior Framing System: TRIFAB VG 451, by Kawneer. 2 x 4-1/2 inch nominal dimension, extruded aluminum flush glazed framing system for insulated glazing systems.

2.4 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Rigidly fit and secure joints and corners. Make joints and connections flush, hairline, and weatherproof.
- C. Develop drainage holes with moisture pattern to exterior.
- D. Prepare components to receive anchor devices. Fabricate anchorage items. Arrange fasteners, attachments, and jointing to ensure concealment from view.
- E. Reinforce framing members for imposed loads.
- F. Accessories:
 - 1. Break Metal Closures: Minimum 0.040 inch thick aluminum x length required. Finish shall match adjacent related work.
 - 2. Provide clean sharp edges, uniform in appearance and consistent in shape. Secure in place with concealed fasteners where possible. Exposed fasteners shall match enclosure fabrication.

3. Sill Flashing: Fabricate to configuration indicated and required of minimum 0.040 inch aluminum having exposed edges hemmed. Finish to match adjacent related work.

2.5 FINISHES

- A. Exposed Aluminum Surfaces: Architectural Class I anodic coating AA-M12 C22 A41, conforming to AAMA 611, 0.018 mm minimum thickness #14 Clear, unless otherwise indicated on Drawings.
- B. Provide clear finish for all new storefront systems unless partial replacement or repair; then, verify and match existing storefront system color. Maintain same color range. Do not mix light and dark shades.
- C. Concealed Steel Items: Galvanized in accordance with ASTM A 123 to 2.0 oz/sq ft.
- D. Apply two coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General Contractor shall provide rough openings including rough masonry openings and modifications to existing aluminum storefront components and glazing as shown on the drawings or as required for complete installation of work specified herein.

3.2 EXAMINATION

- A. Verify wall openings are ready to receive work of this Section. Verify dimensions, tolerances, and method of attachment with other work.
- B. Beginning of installation means acceptance of existing conditions.

3.3 INSTALLATION

- A. Install storefront system components in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely attach frame assembly to structure.
- C. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Break Metals:
 1. Set sill flashing in full bed of sealant. Provide riveted end laps of not less than 3 inches.
- E. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- F. Install perimeter sealant and backing materials in accordance with Section 07900.
- G. Install glass in accordance with Section 08800, to glazing method required to achieve performance criteria.
- H. Set thresholds in bed of mastic and secure.

3.4 TOLERANCES

- A. Variation from Plane: 0.03 inches per foot maximum or 0.25 inches per 30 feet, whichever is less.
- B. Misalignment of Two Adjoining Members Abutting in Plane: 0.015 inches.

3.5 FIELD QUALITY CONTROL

- A. Inspect storefront system installation and attachment to building structure.

3.6 CLEANING

- A. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- B. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 08462 - AUTOMATIC SLIDING ENTRANCE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electric operated automatic sliding entrance doors and control systems, with transom assemblies, including frames, glazing, and hardware.

B. Related Requirements:

1. Section 07900 - Joint Sealers.
2. Section 08800 - Glazing: Storefront system glass.
3. Section 16100 - Wiring Methods: Power to automatic doors.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Convene Pre-installation Conference at Site one week prior to commencing Work of this Section. Require attendance of parties directly affecting Work of this Section, including, but not limited to, Owner's Construction Manager, Contractor Project Field Superintendent, Aluminum Storefront job foreman, Automatic Entrance Door Manufacturer's Technical Representative, electrical subcontractor field supervisory personnel, and any subcontractor, supplier, or installer directly affecting, or affected by Work of this Section.
2. Contact Owner's Construction Manager two weeks prior to Pre-installation Conference to confirm schedule.
3. Review foreseeable methods and procedures related to automatic entrance door Work, including the following:
 - a. Tour, inspect, and discuss condition of door assembly openings, connections to building structure, electrical requirements, and other preparatory work performed by other trades.
 - b. Review automatic entrance door system requirements including drawings, specifications and other contract documents.
 - c. Review required submittals, both completed and yet to be completed.
 - d. Review and finalize construction schedule related to automatic entrance door Work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - e. Review required inspections, operational testing, and certifying procedures.
 - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - g. Review preparation and installation procedures and coordinating and scheduling required with related work.
4. Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURER/INSTALLER

A. [Stanley Access Technologies](#), Farmington, CT.

1. Contact: Vanessa Lopez, National Accounts Project Manager, (860) 507-2509.

2.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference: Attend pre-installation conference at Site one week prior to commencing Work.
 - 1. Review foreseeable methods and procedures related to automatic entrance door Work, including the following:
 - 2. Tour, inspect, and discuss condition of door assembly openings, connections to building structure, electrical requirements, and other preparatory work performed by other trades.
 - 3. Review automatic entrance door system requirements including drawings, specifications and other contract documents.
 - 4. Review required submittals, both completed and yet to be completed.
 - 5. Review and finalize construction schedule related to automatic entrance door Work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - 6. Review required inspections, operational testing, and certifying procedures.
 - 7. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - 8. Review preparation and installation procedures and coordinating and scheduling required with related work.

2.3 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Automatic and barrier free door equipment shall be installed by the manufacturer's factory trained installers or shall be installers as recommended and approved by the automatic door operator manufacturer.
 - 2. Installers shall be certified and recognized by and in accordance with the AAADM Inspector Certification Program.

2.4 PERFORMANCE REQUIREMENTS FOR AUTOMATIC SLIDING ENTRANCE DOORS

- A. Design system to operate, hold open, and close doors under wind and suction loads calculated by the manufacturer based on the design wind loads shown on the Structural Drawings but not less than a wind load pressure of 20 PSF.
- B. Provide for dimensional distortion of components during operation.
- C. Provide for opening and closing operation of door panels in the event of power failure.
- D. Operating Temperature Range: -20 F to 130 F ambient.
- E. Air infiltration: Maximum air leakage through fixed glazing and framing of automatic sliding doors shall be in accordance with ASHRAE 90.1.
- F. Eliminate system performance interference by ambient light and radio frequencies.
- G. Provide sliding doors and side panels with break-away capability where scheduled or shown.

2.5 REGULATORY REQUIREMENTS FOR AUTOMATIC SLIDING ENTRANCE DOORS

- A. Conform to applicable code for automatic release of control drive unit to permit manual opening of doors.
- B. Comply with ANSI A156.10 and ANSI A117.1.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

2.6 AUTOMATIC SLIDING ENTRANCE DOORS

- A. Exterior Doors: Dura-Glide Series 3000 with Stan-Vision by Stanley. Overhead concealed slide door system with sidelights and transom where indicated, full breakout of doors and sidelights unless otherwise scheduled to be non-breakaway, and doorway monitoring device to control door opening, closing, and hold open functions, single or pair as indicated.
- B. Interior Doors: Dura-Glide Series 3000 with Stan-Vision as manufactured by Stanley. Overhead concealed slide door system with sidelights and transom (interior) where indicated, full breakout of doors and sidelights unless otherwise scheduled to be non-breakaway, and doorway monitoring device to control door opening, closing, and hold open functions, single or pair as indicated.
 - 1. Door and Transom Sizes: As shown on Drawings.

2.7 OPERATING SYSTEM COMPONENTS

- A. Visual Sensing System (Motion Detector): Stan-Vision Series as manufactured by Stanley.
 - 1. The system consists of the following major components:
 - a. Two CCD (Closed Circuit Digital) visual sensors with mounting templates, one visual sensor controller, a four-channel encoder, two RG-59 cables for connecting the visual sensors to the visual sensor controller.
 - 2. The system shall connect with the Stanley interface board, motor encoder assembly, and the Stanley Dura-Glide microprocessor control box.
 - 3. Provide one unit center mounted above doorway on each side of header.
- B. Power Requirements: Dedicated 120V AC, 5 Amp, 60 Hz, single phase power with solid earth ground connection.

2.8 DOOR COMPONENTS, HARDWARE AND ACCESSORIES

- A. Doors: Narrow stile aluminum doors.
- B. Top Rail: Manufacturer's standard.
- C. Bottom Rail: 10 inches high.
- D. Horizontal Muntins: Provide two muntins, locate at 24 inches and 42 inches above finish floor. Align with bumper guards and push bars on aluminum storefront system entrance door as indicated on Drawings.
- E. Stiles: 2-1/4 inches.
- F. Finish:
 - 1. Exposed Aluminum Surfaces: Architectural Class II anodic coating, AA-M12 C22 A31, conforming to AAMA 611, 0.010 mm minimum thickness. #17 Clear, unless otherwise indicated on Drawings.
- G. Door Hardware and Accessories:
 - 1. Pivots: Allows break-away sliding panel and sidelights to break away to full open position to provide immediate egress at any point in door movement.
 - a. Panic break-away shall be code approved, acceptable to Authorities Having Jurisdiction.
 - 2. Top Door Arm: Door holders for all break-away door panels.
 - 3. Quick disconnect wiring harness.
 - 4. Power Switch: 5 position "On/Off/Hold Open" switch; full automatic, reduced automatic, and exit only.
 - 5. Adjustable door sweeps (exterior doors only).
 - 6. Finger Protection: Provide finger protection between sidelight and sliding door when door is in open position.
 - 7. Deadlock: Manufacturer's standard deadbolt operated by keyed cylinders on interior and exterior with lock position indicator on the interior.
 - 8. Slide doors shall include two point lock securing lead edges of door stiles together and to hanger assembly.
 - 9. Keyed Cylinder (Exterior): Specified in Section 08710.
 - 10. Recessed Access Control Package.
 - 11. Electric Solenoid Locking System (Exterior Doors): Provide automatic locking mechanism to secure doors

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in closed position when the door is closed to outside entry (ENTER/NO). Provide fail-secure control. Provide door unit with exterior access by key control switch mounted at outside jamb to disengage electric solenoid locking system and open door.

12. "Watchdog" monitoring of microprocessor.
13. Perimeter pile weatherstripping.
14. Thresholds:
 - a. Provide aluminum threshold of profile shown for doors when scheduled in Section 08710.
 - b. Provide edge profile suitable for installation adjacent to entrance tile where applicable.
15. Length: Opening width plus 2 inches minimum.
16. Glass Guards (Crash Bars): Nominal 1/2 inch by 2 inch aluminum bar with 1 inch projection from mounting surface. Mount on doors where and as shown on Drawings

H. Doors shall be rendered non-breakaway when scheduled on Drawings.

2.9 GLASS

- A. Glass shall be type as specified below and conforming to the requirements specified in Section 08800.
- B. Interior Doors, Sidelites, and Transoms: Clear tempered glass.
- C. Exterior Doors, Sidelites, and Transoms.
 1. Tinted tempered glass, Reference 08800 for tint color

2.10 EXAMINATION

- A. Examine existing conditions with Contractor prior to start of door installation.
- B. Examine surfaces and adjacent areas in which Work is performed. Report conditions that may adversely affect satisfactory execution. Do not proceed with Work until unsatisfactory conditions have been corrected.

2.11 INSTALLATION

- A. Install products in accordance with manufacturer's published instructions.
- B. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or stress.
- C. Install hardware in accordance with ANSI A117.1 requirements and local adopted disabled access requirements for hardware.
- D. Seal joints between door frames and walls in accordance with requirements specified in Section 07900.

2.12 TESTING AND INSPECTION

- A. Site Tests: Upon completion of installation, test operation of automatic entrance doors and operating system. Make all necessary adjustments as required and retest.
- B. Inspection:
 1. Inspect automatic entrance doors and operating system installation in accordance with AAADM requirements.
- C. Correct deficiencies in Work which inspection indicates are not in compliance with Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions with Automatic Entrance Door Supplier prior to start of door installation.

3.2 PREPARATION BY CONTRACTOR

- A. Provide door openings to size indicated on Drawings.
- B. Provide door head level and parallel with floor at door opening. Size and configuration shall be as indicated on the Drawings.
- C. Provide door jambs parallel and plumb.
- D. Provide power to location at door required by door manufacturer ready for power connection.

3.3 INSTALLATION BY CONTRACTOR

- A. Install automatic entrance doors and operating systems with all components including glass, hardware, and accessories.
- B. Make final power connections to automatic entrance doors as specified in Section 16100.
- C. Furnish and install keyed cylinder and thumbturn if and where specified in Section 08710.
- D. Interface with Other Work:
 - 1. Coordinate locations of power connections and requirements.
 - 2. Coordinate locations of building management alarm connections and requirements.
 - 3. Coordinate requirements for door openings required for automatic entrance door installation.

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END OF SECTION

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SECTION 08560 – SLIDING TRANSACTION WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sliding, transaction windows.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.
- B. Shop Drawings: For sliding transaction windows.
 - 1. Include plans, elevations, sections, and attachments to other work.
 - 2. Hardware for sliding window units.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Pack sliding transaction windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label sliding transaction window packaging with drawing designation.
- C. Store crated sliding transaction windows on raised blocks to prevent moisture damage. Store under cover in dry location.
- D. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication or hold required finish opening dimensions coordinated with installer. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace sliding transaction windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding 1/4 inch.
 - b. Failure of welds.
 - c. Faulty operation of sliding window hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SLIDING, TRANSACTION WINDOWS

- A. Provide horizontal-sliding, transaction windows.
 - 1. Basis of Design: CRLaurence Co., Inc., Aluminum DW Series, deluxe manual sliding "XX" service window without screens, No. DW4200A.
- B. Configuration: Two glazed panels that each slide horizontally, equally divided.
- C. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:
 - 1. Head Profile: Manufacturer standard depth aluminum frame modules, constructed of 6063-T5 extruded aluminum. Window glides on top-hung heavy-duty ball bearing slides. Poly-pile weather stripping and self-latching handle.
 - 2. Depth: Manufacturer's standard.
 - 3. Finish: Clear anodized.
- D. Sliding Window Hardware: Provide roller track designed for overhead support of two- or four-wheel carriage supporting horizontal-sliding glazed panel. Provide manufacturer's standard pull and latch for each horizontal-sliding glazed panel.
 - 1. Omit continuous threshold or bottom track. Utilize 4" long "half track" where operable panels overlap.
- E. Glazing and Glazing Materials: Comply with requirements in Division 08 Section "Glazing."
 - 1. Thickness: ¼ inch, clear tempered.
- F. Materials:
 - 1. Aluminum Extrusions: ASTM B 221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 20,000-psi ultimate tensile strength.
 - 2. Aluminum Sheet and Plate: ASTM B 209.

2.2 FABRICATION

- A. General: Fabricate sliding transaction windows to provide a complete system for assembly of components and anchorage of window units.
 - 1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
 - 2. Prepare sliding transaction windows for glazing unless preglazing at the factory is indicated.
- B. Framing: Miter corners the full depth of framing; weld and dress smooth.
- C. Glazing Stops: Finish glazing stops to match sliding transaction window framing.
 - 1. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- E. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Division 08 Section "Glazing."

2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.5 ACCESSORIES

- A. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
- B. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.
- C. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- D. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
 - 1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
 - 2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
 - 3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
- F. Sealants: For sealants required within fabricated windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sliding transaction windows.
- B. Inspect anchoring substrates to verify that they are suitable for installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Removable Glazing Stops and Trim: Fasten components with fasteners.
- B. Fasteners: Install sliding transaction windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.
- C. Sealants: Comply with requirements in Division 07 "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Seal frame perimeter with sealant to provide airtight construction unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 ADJUSTING

- A. Adjust horizontal-sliding, transaction windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
 - 1. Ensure latches easily and automatically securely latch when sliding windows are closed.
- B. Remove and replace defective work, including sliding transaction windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of sliding transaction windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
 - 1. Lubricate sliding window hardware.
- B. Clean glass of preglazed windows promptly after installation, complying with requirements in manufacturer's written instructions.
- C. Provide temporary protection to ensure that sliding transaction windows are without damage at time of Substantial Completion.

END OF SECTION

SECTION 08565 - ALUMINUM BULLET RESISTANT TRANSACTION WINDOW

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Aluminum bullet resistant transaction windows as indicated in drawings.
- B. The publication below forms a part of this specification:
 - 1. UNDERWRITERS LABORATORY UL 752 9th Edition Standard for Bullet Resisting Equipment dated Jan. 27, 1995.

1.2 SUBMITTALS

- A. Product Data: Submit Manufacturer's technical product data substantiating that products comply.
- B. Shop drawings: Submit for fabrication and installation of windows. Include details, elevations and installation requirement of finish hardware and cleaning.
- C. Certification: Provide printed data in sufficient detail to indicate compliance with the contract documents.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver windows crated to provide protection during transit and job storage.
- B. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.
- C. Store windows at building site under cover in dry location.

1.4 PROJECT CONDITIONS

- A. Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.5 WARRANTY

- B. All material and workmanship shall be warranted against defects for a period of one (1) year from the original date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design: Design is based on aluminum bullet resistant transaction windows,
 - 1. N1EW12A Exterior Glazed Exchange Window by C.R. Laurence Co., Inc. (800) 421-6144

2.2 MATERIALS

- A. Frames: Aluminum bullet resistant frame modules shall be to the standards established by U.L. 752 Protection Level 1. Frames are to be constructed of 6063-T5 extruded aluminum. Replacement of glazing shall be from the secure side of the window or wall unit and does not require the removal of the frame from the opening. Shapes and sizes are to be in accordance with the contract drawings. FRAMES MUST UTILIZE TESTING

RECOGNIZED UNDER THE STANDARDS ESTABLISHED BY U.L. 752 FOR BULLET RESISTANT COMPONENTS.

- B. Finish: All aluminum to be clear anodized.
- C. Glazing: The glazing must be in accordance with U.L. 752 testing standards
- D. Level 1. Laminated, clear glass.

2.3 ACCESSORIES

- E. Shelf: Recessed, Nonricochet Deal Trays: Formed from stainless steel. fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface.
 - 1. Clear Opening Size: Nominal 10 inches wide by 7 inches deep by 1-1/2 inches high
 - 2. Bullet Trap Location: Secure side.
 - 3. Ballistics Resistance: Listed and labeled as bullet resisting according to UL 752 to same level as security window.
- F. Voice Transmission: Electronic talk-thru unit, circular shape, mounted in the glass with speakers facing both directions and adjustable snake-arm microphone and controls on the secure side of the assembly.
 - 1. Basis of Design: The design for Talk Thru Unit is TTU-1ABX-PTT-NC by Norcon Communications.
 - a. Power supply: 120V AC power routed thru 3/8" diameter tubing within glazing.
 - b. Ballistics Resistance: Listed and labeled as bullet resisting according to UL 752 to same level as security window.
 - c. Push to Talk: Requires a switch to be operated to activate internal microphone.
 - d. Noise Cancellation: Automatically lowers outside ambient noise.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install frames and glazing in accordance with manufacturer's printed instructions and recommendations. Repair damaged units as directed (if approved by the manufacturer and the architect) or replace with new units.

3.2 CLEANING

- A. Clean frame and glazing surfaces after installation, complying with requirements contained in the manufacturer's instructions. Remove excess glazing sealant compounds, dirt or other substances.

3.3 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that all the windows do not incur any damage or deterioration, other than normal weathering, at the time of acceptance.

END OF SECTION

SECTION 08710 - DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hardware for doors.
 - 2. Thresholds.
 - 3. Weatherstripping, seals and door gaskets.

- B. Related Requirements:
 - 1. Section 01600 – Product Requirements: Contractor’s Products Selection checklist.
 - 2. Section 03310 - Cast-In-Place Structural Concrete: Non-shrink grout for thresholds.
 - 3. Section 06100 - Rough Carpentry: Blocking for miscellaneous hardware mounting.
 - 4. Section 06400 - Architectural Woodwork: Hardware for cabinetry and other finish carpentry.
 - 5. Section 08110 - Steel Doors and Frames: Hardware coordination.
 - 6. Section 08462 - Automatic Sliding Entrance Doors: Hardware coordination.
 - 7. Section 16100 - Wiring Methods: Electrified hardware coordination.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

- B. Americans with Disabilities Act (ADA):
 - 1. 28 CFR Part 36 – ADA Standards for Accessible Design.

- C. American National Standards Institute (ANSI):
 - 1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
 - 2. ANSI A 156.2 - Bored and Preassembled Locks and Latches.
 - 3. ANSI A 156.6 - Architectural Door Trim.
 - 4. ANSI A 156.13 - Mortise Locks and Latches.
 - 5. ANSI A 156.15 - Release Devices – Closer Holder, Electromagnetic and Electromechanical.

- D. National Fire Protection Institute (NFPA):
 - 1. NFPA 80 - Fire Doors and Windows.
 - 2. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 - 3. NFPA 252 - Fire Tests of Door Assemblies.

- E. Underwriters Laboratories (UL):
 - 1. UL 10B - Fire Tests of Door Assemblies.
 - 2. UL 305 - Panic Hardware.

1.3 SUBMITTALS

- A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. System schematic.
 - b. Point-to-point wiring diagram.

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- c. Riser diagram.
 - d. Elevation of each door.
 - 2. Detail interface between electrified door hardware and access control system.
- C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
- D. Keying Schedule: Prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- E. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Product Packaging: Hardware will be shipped in manufacturer's standard packaging with identification markings on each component or package.
- C. Receive and accept products and report suspected defects and shipping discrepancies in compliance with the requirements of Section 01600.
- D. Product Compliance Inspection: Inspect delivered products for compliance with product descriptions in Part 2 herein. Report discrepancies to the Architect.
- E. Store products in unopened packages in protected dry area to prevent damage from environmental and construction operations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide hardware as manufactured by those listed in the Hardware Manufacturer Designation schedule in this Part 2. Provide hardware components as Scheduled in the Hardware Schedule in Part 3 of this Section.
- B. Provide products by the manufacturers listed herein. No substitutions allowed.
- C. Product Designations: Hardware may be any of the products listed within the tables below for each specific type. Substitutions will not be permitted.

D. Hardware Manufacturer Designations:

ID	Manufacturer	Telephone
H	Hager Companies	(800) 325-9995
I	H. B. Ives (Allegion)	(877) 671-7011
LCN	LCN Closers (Allegion)	(877) 671-7011
L	Locknetics (Allegion)	(877) 671-7011
Mc	McKinney (Assa Abloy)	(800) 346-7707
Na	National Guard Products, Inc.	(800) 647-7874
P	Pemko Mfg. Co. (Assa Abloy)	West Coast (800) 283-9988 East Coast (800) 824-3018

ID	Manufacturer	Telephone
Po	Positive Lock	(800) 342-7670
Re	Reese Enterprises, Inc.	(800) 328-0953
Ro	Rockwood (Assa Abloy)	(814) 926-2026
Sc	Schlage (Allegion)	(888) 805-9837
S	Stanley Hardware	(855) 365-2407
T	Trimco (Triangle Brass Mfg.)	(323) 262-4191
VD	Von Duprin (Allegion)	(877) 671-7011

2.2 SUPPLIERS

- A. Provide door hardware from one of the following national or local suppliers.
1. [DH Pace, Inc.](#), Springfield, MO, Mark Lyons, (417) 831-5585.
 2. [Positive Lock](#) (Alarm Exit Device) - Contact: Kimbra White, (800) 342-7670.

2.3 REGULATORY REQUIREMENTS

- A. Perform work in accordance with the following standards:
1. ANSI A117.1
 2. NFPA 101.
 3. NFPA 80.
 4. NFPA 252.
 5. UL 10B.
 6. UL 305.
- B. Conform to applicable code for requirements applicable to fire rated doors and frames.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. (UL), and acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.
- D. Conform to applicable local, State or Federal disabled access requirements for the installation and operation of door hardware.

2.4 FINISHES

- A. Provide finishes as specified in Part 2 of this Section unless otherwise indicated in the Hardware Schedule for the specific hardware item.

2.5 HINGES

- A. Material:
1. Mortise Butts: Provide full mortise-type hinges with stainless steel pins, except steel pins with steel hinges; non-removable pin (NRP) for exterior and public interior exposure, non-rising pin, flat button with matching plugs, 4-1/2 inches x 4-1/2 inches unless otherwise shown.
 2. Ball-bearing Type Hinges: Swaged, inner leaf beveled, square corners.
 3. Full-surface Reinforcing Pivot:
 - a. For 4-1/2 inch butts with standard 1/4-inch backset.
 - b. Install per manufacturer's written instructions using attachments furnished with pivot.

B. Hinges by types:

Type	Description	Finish	MANUFACTURER/MODEL		
			Stanley	Hager	McKinney
H-4	Butts: Medium weight door, average frequency, steel	652	FBB179	BB1279	TB2714

2.6 LOCKS, LATCHES, AND BOLTS

A. Materials:

1. Cylindrical Locks: ANSI A156.2, Series 4000 Grade 1, equipped with 6-pin tumbler; "keyed alike" to match keying system of existing locks to remain if compatible. Provide 2-3/4 inch backset. Provide two keys for each lock.
2. Mortise Locks: ANSI A156.13, Grade 1, equipped with 6-pin tumbler; "keyed alike" to match keying system of existing locks to remain. Provide 2-3/4 inch backset. Provide two keys for each lock.
3. Provide Schlage standard C123 keyway.
4. Master key, key alike or different as directed.
5. Quantity: In addition to two keys for each lock, provide the following:
 - a. Cylinder Change Keys: 6 change keys per change
 - b. Master Keys: 10.
6. Latch Sets: Provide push-button releases by turning lever, closing door, or turning emergency release key through hole in outside lever.
7. Strikes: ANSI Strikes, 1-1/4 inches x 4-7/8 inches, with curved lip. Wrought box strikes, with extended lip for latch bolts, except open strike plates may be used in wood frames. Provide dustproof strikes for foot bolts.
8. Tactile Warning: Provide locks with tactile warning for handicapped codes when required by local jurisdiction having authority.

B. Locks by types:

Type	Description	Finish	MANUFACTURER/MODEL
			Schlage
L-3	Rim Cylinder	626	20-022
L-4	Classroom Lock	626	ND70PD Rhodes
L-5	Storeroom Lock (F86)	626	ND80PD-Rhodes- 25
L-6	Office Lock (F82)	626	ND50PD-Rhodes-10-025
L-7	Passage Latch (F75)	626	ND10S - Rhodes- 10-025
L-8	Privacy Lock (F76)	626	ND40S - Rhodes- 10-025

2.7 EXIT DEVICES

A. Materials:

1. Provide exposed metal to match hardware.
2. Size and mount units indicated or, if not indicated, to comply with manufacturer's recommendations for exposure condition. Reinforce substrate as recommended.

B. Exit Devices by types:

Type	Description	Finish	MANUFACTURER/MODEL
			Von Duprin, unless otherwise noted.
E-16	Exit Device: Rim, lever trim,	626	99L-992L-NL

2.8 PULLS AND PUSHES

- A. Materials: ANSI A156.6 for 0.050 inch thickness.

B. Push and Pulls by types:

Type	Description	Finish	MANUFACTURER/MODEL		
			Ives	Trimco	Rockwood
P-1	Push 3-1/2 inches x 15 inches	630	8200	1001-2	70B
P-2	Pull 3-1/2 inches x 15 inches	630	8311-5	1012-2	137x70B

2.9 CLOSERS

A. Materials & Features:

1. ANSI A156.4, grade 1.
2. ADA/ANSI A117.1
3. UL listed.
4. Non-handed, non-sized; adjustable 1-6.
5. 180 degree door opening.
6. Standard cover.
7. Multiple backcheck location valve.
8. Extreme temperature fluid.
9. Sex nuts and bolts (SNBs).
10. Provide exposed metal to match hardware.
11. Size and mount units indicated or, if not indicated, to comply with manufacturer's recommendations for exposure condition. Reinforce substrate as recommended.

B. Closers by types:

Type	Description	Finish	MANUFACTURER/MODEL
			LCN
C-6	Closer: Regular Arm	689	4031-REG
C-7	Closer: Parallel Arm	689	4031-EDA
C-10	Closer: Regular Arm, HO	689	4031-H
C-11	Closer: Parallel Arm, positive stop	689	4031-CUSH

2.10 DOOR PROTECTION PLATES

- A. Materials: J100 Protection Plates conforming to ANSI 156.6, stainless steel, 0.050 inch (1.2 mm) minimum thickness. Mount centered, flush with bottom of door. Screws: Phillips head sheet metal screws plated to match plate.

B. Protection Plates by types:

Type	Description	Size	Finish	MANUFACTURER/MODEL		
				Ives	Trimco	Rockwood
K-2	Kick Plate	10 inch x (DW-2 inch)	630	8400	K1050	J102

2.11 STOPS, HOLDERS AND BUMPERS

A. Materials:

1. Door stop mounting: Methods to suit substrates encountered (plastic anchor, drywall anchor, expansion shield).
2. Provide gray rubber exposed resilient parts.
3. Do not furnish aluminum floor stops.
4. For most doors, the preferred door stop is Wall Stop type S-1 and is specified as such in the hardware schedule. However, if circumstances prevent a wall stop installation (door too far from perpendicular wall, door swing into adjacent glass, etc.) then substitute a type S-4 floor stop as indicated for use intended.
5. Adjust height of floor stops to suit undercut of adjacent door.

B. Stops, Holders and Bumpers by types:

Type	Description	Finish	MANUFACTURER/MODEL		
			Ives	Trimco	Rockwood
S-1	Wall Stop	630	WS407CVX	W1276CS	409
S-4	Floor Stop	626	FS438	1212 3/4ES	442

2.12 THRESHOLDS

A. Thresholds by types:

Type	Description	MANUFACTURER/MODEL		
		National Guard	Pemko	
T-1	Threshold: 5 inches x 1/2 inch, abrasive.	425HD-SIA 5"	1715AK 5"	

2.13 WEATHERSTRIPPING

A. Weatherstripping by types:

Type	Description	MANUFACTURER/MODEL		
		National Guard	Pemko	Reese
W-1	Jamb & Head Weatherstripping, aluminum, vinyl insert, screw-on type	155V	303AV	807A

2.14 MISCELLANEOUS HARDWARE

- A. Silencers: Provide in metal door frames, unless not permitted for fire rating, or unless bumper-type weatherstripping is provided; three for each single door frame, two for double-door frame.

B. Miscellaneous Hardware by types:

Type	Description	Size	Finish	MANUFACTURER/MODEL		
				Pemko		
M-1	Automatic Door Bottom		602	4131CRL-36		
				Ives	Trimco	Rockwood
M-5	Extension Flush Bolts (UL)	12 inches	626	458	3917	555
				Ives	Trimco	Rockwood
M-8	Silencers			SR64	1229-A	608
				National Guard	Pemko	Reese
M-9	Drip Cap			16AD	346CxFW	R201A
				Ives		
M-10	Foot Pull			FP100		
				Von Duprin	Securitron	
M-15	Electric Strike, grade 1, FSE (fail secure), 24 VDC unless noted otherwise in schedule		630	6211		
M-16	Electric Strike		626		UNL-24	
				HES	Locknetics	
M-20	Electric Strike, grade 1, FSE (fail secure), 24 VDC unless noted otherwise in schedule		630	8000 C	NC 450	

2.15 FABRICATION

- A. Finish and Base Material Designations: Number indicates Builders Hardware Manufacturer's Association (BHMA) Code or nearest traditional U.S. commercial finish.
- B. Where base material and quality of finish are not otherwise indicated, provide at least commercially recognized quality.

- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive Work and dimensions are as instructed by the manufacturer.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

- A. Hardware Mounting Heights: Door and Hardware Institute Recommended Locations for Builders Hardware for Standard Steel Doors and Frames, except as otherwise indicated.
 - 1. Conform to requirements of applicable local, State or Federal disabled access requirements for the installation and operation of door hardware.
- B. Install each hardware item to comply with manufacturer's instructions and recommendations, unless otherwise specified.
- C. Thru-bolt closers on doors.
- D. Vestibule Thresholds: Install as shown on Drawings.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust hardware for proper operation and function at construction completion. Instruct Owner personnel in proper maintenance and adjustment.

3.4 HARDWARE SCHEDULE

- A. The Door Schedule as shown on the drawings represent the full set of hardware for each door listed. Refer to the Door Schedule and Schedule Notes for actual hardware components required for each door in this project.
- B. For interior hollow metal doors and exterior building hollow metal doors which have a tactile exit sign installed on the door, install a door closer (C-7) if a closer does not exist on the door.
- C. Refer to Drawings for Hardware Schedule.

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END OF SECTION

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SECTION 08800 - GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass and glazing for interior and exterior metal frames and doors.
2. Glass and glazing for standard storefront and manual swing entrance doors.
3. Window Hardware: Sliding glass track assembly.
4. Glazing for interior and exterior automatic sliding storefront doors, transoms, and sidelites as scheduled.

B. Related Requirements:

1. Section 08110 - Steel Doors and Frames: Glazed doors and fixed window frames.
2. Section 08411 - Aluminum Framed Storefronts: Aluminum storefront framing system.
3. Section 08462 - Automatic Sliding Entrance Doors: Glazed doors.
4. Section 08710 - Door Hardware: Hardware coordination.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the test by these basic designations only.

B. American National Standards Institute (ANSI):

1. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

C. ASTM International (ASTM):

1. ASTM C920 - Specification for Elastomeric Joint Sealants.
2. ASTM C1036 - Flat Glass.
3. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
4. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.
5. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
6. ASTM E 1996 - Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. Flat Glass Marketing Association (FGMA):

1. FGMA - Glazing Manual and Glazing Sealing Systems Manual.

E. Consumer Product Safety Standards for Architectural Glazing.

1. CPSC 16 CFR, Part 1201.

1.3 QUALITY ASSURANCE

A. Conform to FGMA Glazing Manual for glazing installation methods.

B. Provide permanent labeling for safety glass indicating conformance with specified standards.

PART 2 PRODUCTS

2.1 GLASS MATERIALS

A. Tempered Glass: ASTM C 1048, Kind FT (Fully Tempered), Condition A (Uncoated), Type I (Transparent Glass, Flat), Quality q3 (Glazing Select).

1. Conform to ANSI Z97.1 and CPSC 16CFR Part 1201.
2. Tempered glazing panels as specified in the Glass Schedule below (including doors, sidelights, storefronts, and transoms) shall comply with the CPSC 16CFR Part 1201 criteria for Category I or II as follows:
 - a. Glazing Panels 9 sq. ft. or less: Category I.
 - b. Glazing Panels more than 9 sq. ft.: Category II.
 - c. Thickness:
 - 1) Doors and Window Frames: 1/4 inch unless otherwise shown or specified.
3. Clear: Class 1 (Clear).
4. Tinted: Class 2 (Tinted Heat Absorbing and Light Reducing).
 - a. Color: Gray tint.

B. Insulated Units: Double pane units, with hermetically sealed air space between.

1. Clear: Both inner and outer panes of clear glass
2. Tinted: Inner pane of clear glass and outer pane of tinted glass.
3. Unit Thickness: 1 inch thick units; 1/4 inch thick tempered inner and outer panes, with 1/2 inch air space.

C. Identification:

1. Each unit of tempered glass shall be permanently identified by the manufacturer. The identification shall be etched or ceramic fired on the glass and be visible when the unit is glazed.

2.2 GLAZING COMPOUNDS

A. Polysulphide Sealant: Two component, chemical curing, non-sagging type; cured Shore A hardness of 15-25.

B. Silicone Sealant: Single component, chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining; cured Shore A hardness of 15-25.

1. Color: Clear.

C. Acrylic terpolymer compounded especially for glazing; non-hardening, non-staining, and non-bleeding.

2.3 GLAZING ACCESSORIES

A. Setting Blocks: Resilient blocks of 70 to 90 Shore A durometer hardness; compatible with glazing sealant.

B. Spacers: Resilient blocks of 40 to 50 Shore A durometer hardness; self adhesive on one side; compatible with glazing sealant.

C. Filler Rods: Closed cell or jacketed foam rods of polyethylene, butyl, neoprene, polyurethane, or vinyl; compatible with glazing sealant.

D. Joint Cleaners, Primers, and Sealers: As recommended by glazing sealant manufacturer.

E. Gaskets: ASTM D2000, SBC 415 to 3BC 620; extruded or molded neoprene or EPDM, black.

2.4 SLIDING WINDOW HARDWARE

A. Sliding Glass Track: Zinc-plated steel sliding glass window track assembly including upper channel, shoe, ball-bearing carrier, lower track, and nickel finish adjustable lock. Provide sliding glass window assembly Model No. KV P992 and Lock KV 965, as manufactured by Knappe & Vogt Manufacturing Company.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this Section.

B. Beginning of installation means acceptance of substrate.

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3.2 PREPARATION

- A. Clean contact surfaces; prime or seal where recommended by sealant manufacturer for intended application.
- B. Inspect glass edges immediately prior to setting; discard those with edge damage that will contribute to glazing failure.

3.3 GLAZING

- A. Locate setting blocks at quarter points of sill; set in sealant if heel or toe bead is required.
- B. Install spacers inside and out except where pre-shimmed tape or glazing gaskets are to be used.
- C. Set each piece in a series to other pieces in pattern draw, bow, or other visually perceptible characteristics.
- D. Provide glazing sealants and gaskets as required for particular glazing application. Coordinate with other Sections for material compatibility.
- E. Gaskets:
 - 1. Provide adequate anchorage, particularly for driven-in wedge gaskets.
 - 2. Miter and weld ends of channel gaskets at corners to provide continuous gaskets.
 - 3. Seal face gaskets at corners with sealant to close opening and prevent withdrawal of gaskets from corners.
- F. Do not leave voids in glazing channels except as specifically indicated or recommended by glass manufacturer. Force sealant into channel to eliminate voids. Tool exposed surfaces to slight wash away from joint. Trim and clean promptly.
- G. Do not allow sealant to close weeps of aluminum framing.
- H. Provide filler rod where sealants are used in the following locations:
 - 1. Head and jamb channels.
 - 2. Colored glass over 75 united inches in size.
 - 3. Clear glass over 125 united inches in size.

3.4 SLIDING WINDOW TRACK INSTALLATION

- A. Attach sliding window track assembly to hollow metal frame with double faced tape or adhesive as recommended by the manufacturer.

3.5 ADJUSTING AND CLEANING

- A. Immediately prior to Wal-Mart acceptance of Project, replace broken or otherwise damaged glass. Wash and polish glass inside and out.

3.6 GLASS SCHEDULE

- A. Provide type of glass specified for the applications scheduled as follows:

APPLICATION/LOCATION	TYPE OF GLASS
Interior Windows	Clear tempered glass unless otherwise shown or specified.
Interior Hollow Metal Doors	Clear tempered glass.
Interior storefront including storefront doors	Clear tempered glass
Exterior storefront	Insulating tinted tempered glass.

Automatic Sliding Doors and Transoms	Tinted tempered glass.
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END OF SECTION

SECTION 09250 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior non load-bearing steel stud partition framing 20 (30 mil) gage and lighter (designed for 5 pounds per square foot uniform load perpendicular to partition).
 2. Gypsum board.
 3. Backer materials: Backer panels for wall tile and plastic wall panels.
- B. Related Sections:
1. Section 01351 – Regulatory
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 2. Section 06100 - Rough Carpentry: Wood furring strips, plywood, blocking, and fasteners attached to partition framing.
 3. Section 07210 - Building Insulation: Thermal and acoustical insulation.
 4. Section 09900 - Paints and Coatings: Paint finish applied to gypsum board.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the test by these basic designations only.
- B. ASTM International (ASTM):
1. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 2. ASTM C 475 - Joint Compound and Joint Tape for Finishing Gypsum Board.
 3. ASTM C 557 - Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 4. ASTM C 645 - Nonstructural Steel Framing Members.
 5. ASTM C 754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 6. ASTM C 840 - Application And Finishing Of Gypsum Board.
 7. ASTM C 954 - Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 inches to 0.112 inches in Thickness.
 8. ASTM C 1002 - Steel Self-Piercing Tapping Screws For The Application Of Gypsum Panel Products Or Metal Plaster Bases To Wood Studs Or Steel Studs.
 9. ASTM C 1177 - Glass Mat Gypsum Substrate for Use as Sheathing.
 10. ASTM C 1178 - Coated Glass Mat Water-Resistant Gypsum Backing Panel.
 11. ASTM C 1278 – Fiber-Reinforced Gypsum Panel (Backer).
 12. ASTM C 1288 – Fiber-Cement Interior Substrate Sheets (Backer).
 13. ASTM C 1396 - Gypsum Board.
 14. ASTM C 1629 - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 15. ASTM C 1658 - Glass Mat Gypsum Panels.
 16. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surfaces of Interior Coatings in an Environmental Chamber.
 17. ASTM D 3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation.
- C. Gypsum Association (GA):
1. GA-214 - Levels of Gypsum Board Finish.
 2. GA-216 - Application and Finishing of Gypsum Board.
 3. GA-234 - Control Joints For Fire-Resistance Rated Systems.

4. GA-600 - Fire Resistance and Sound Control Design Manual.

D. Occupational Safety and Health Administration (OSHA):

1. OSHA 01926.1153 Respirable Crystalline Silica.

E. Steel Stud Manufacturer's Association (SSMA)

1. Member listing

F. Steel Framing Industry Association (SFIA)

1. Member listing

1.3 ENVIRONMENTAL REQUIREMENTS

A. Minimize dust emissions and provide equipment that suppresses dust.

B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in the installation of light gage metal framing components and gypsum wallboard with minimum 5 years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Transport, handle, store, and protect products.

B. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

C. Store and protect metal framing with weatherproof covering, and ventilate to avoid condensation.

D. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

E. Stack gypsum board flat to prevent sagging.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements:

1. Establish and maintain environmental conditions for applying and finishing gypsum board in conformance with GA-216.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency. Products used in the assembly shall carry a classification label from a testing laboratory acceptable to Authority Having Jurisdiction.

2.2 GYPSUM BOARD MATERIALS

A. Manufacturer: United States Gypsum Company, Chicago, IL. (800) 874-4968.

1. American Gypsum Company, Dallas, TX (800) 545-6302.

2. [CertainTeed Corp](#), Tampa, FL. (800) 233-8990.

3. [Georgia-Pacific](#), Atlanta, GA. (800) 284-5347.

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4. [National Gypsum Company](#), Gold Bond Building Products, Charlotte, NC. (800) 628-4662.
 5. USG Corporation, Chicago, IL. (800) 850-3839.
 6. [The Steel Network](#), Raleigh, NC (888) 474-4876. (Accessories only)
 7. ClarkDietrich, West Chester, OH (513) 870-1100. (Accessories only).
 8. [Fry Reglet](#), (800) 237-9773. (Accessories only)
 9. Other manufacturers listed as members of SSMA, or SFIA.
- B. Standard Gypsum Board: Sheetrock, ASTM C 1396
1. Thickness: 5/8 inch thick
 2. Length, Long Edges, Cut: Maximum permissible length, edges tapered, ends square cut square.
 3. Provide one of the following:
 - a. Gypsum Wallboard by American Gypsum.
 - b. CertainTeed Regular Gypsum Board by CertainTeed.
 - c. ToughRock Gypsum Board by Georgia-Pacific.
 - d. Gold Bond Gypsum Board by National Gypsum.
 - e. Sheetrock Gypsum Panel by United States Gypsum.
- C. Water Resistant Gypsum Board: ASTM C 1396.
1. Thickness: 5/8 inch thick
 2. Length, Long Edges, Cut: Maximum permissible lengths, edges tapered, ends square cut square.
 3. Core: Moisture or mold resistant core.
 4. Mold Resistance: Score of 10 when tested in accordance with ASTM D 3273/3274.
 5. Provide one of the following:
 - a. M-Bloc Mold and Moisture Resistant by American Gypsum.
 - b. M2Tech Gypsum Board by CertainTeed.
 - c. DensArmor Plus by Georgia-Pacific.
 - d. Gold Bond Brand XP Gypsum Board by National Gypsum.
 - e. Sheetrock Brand Mold Tough Gypsum Panel by United States Gypsum.
- D. Fire Resistant Gypsum Board: ASTM C 1396, Type X
1. Thickness: 5/8 inch
 2. Length, Long Edges, Cut: Maximum permissible lengths, edges tapered, ends square cut.
 3. Provide one of the following products:
 - a. FireBloc Type X by American Gypsum.
 - b. CertainTeed Type X Gypsum Board by CertainTeed.
 - c. ToughRock Fireguard X by Georgia-Pacific.
 - d. Gold Bond Fire Shield by National Gypsum.
 - e. Sheetrock Firecode X Gypsum Panel by United States Gypsum.
- E. Water and Fire Resistant Gypsum Board: ASTM C 1396, Type X
1. Thickness: 5/8 inch.
 2. Length, Long Edges, Cut: Maximum permissible lengths, edges tapered, ends square cut.
 3. Core: Non-combustible fire-resistant and mold resistant core.
 4. Mold Resistance: Score of 10 in accordance with ASTM D3273/3274.
 5. Provide one of the following:
 - a. M-Bloc Mold Resistant Type C by American Gypsum.
 - b. Gold Bond Brand XP Fire-Shield C Gypsum Board, by National Gypsum.
 - c. Sheetrock Mold Tough Firecode Type X Gypsum Panel, by United States Gypsum.
 - d. ToughRock Fireguard X Mold-Guard Gypsum Board by Georgia Pacific.
 - e. M2Tech Type X Gypsum Board or Diamondback Glasroc Tile Backer Type X by CertainTeed.
- F. Gypsum Board Fasteners:
1. Metal Framing: ASTM C 954 and C 1002, Type S-12 bugle head, corrosion-resistant self-drilling self-tapping steel screws.
 - a. One Layer 1/2 Inch: 1 inch.
 - b. One Layer 5/8 Inch: 1-1/8 inch.
 - c. Two Layers: 5/8 Inch: 1-7/8 inch.

2. Wood Furring: ASTM C 1002, 1-1/4 inch, Type W bugle head, corrosion-resistant self-drilling steel screws.

G. Gypsum Board Accessories:

1. Corner Beads: Sheetrock Brand No. 104 Dur-A-Bead galvanized steel corner bead by United States Gypsum.
2. Edge Trim: Galvanized steel casing.
 - a. No. 200-B, L shape by United States Gypsum for tight abutment at edges.
 - b. No. 200-A, J shape by United States Gypsum at other locations.
3. Control Joint Accessory Piece:
 - a. No. 093 roll-formed zinc by ClarkDietrich.
4. Vertical Movement Joint Trim:
 - a. No DRMZ-625-200 aluminum Z shape trim by Fry Reglet.
5. Adhesive:
 - a. Commercial Adhesive complying with ASTM C 557.
6. Acoustical Insulation:
 - a. Unfaced fiberglass batts specified in Section 07210.

2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper tape.
2. Backer Panels:
 - a. Glass-Mat Backer Material: 10/10 grid glass mesh tape.

C. Joint Compound

1. Interior Gypsum Wallboard:
 - a. Sheetrock Brand Ready-Mixed Lightweight All-Purpose Joint Compound with Dust Control, by United States Gypsum.
 - b. ProForm Lite Ready Mix Joint Compound with Dust-Tech by National Gypsum.
2. Backer Panels:
 - a. Glass-Mat Backer Materials: Use setting-type taping compound as recommended by backer panel manufacturer and that is rated 10 when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274.

2.4 BACKER MATERIALS

- A. Glass-Mat Backer Materials: Provide glass-mat moisture resistant gypsum core backer materials complying with ASTM C 1178. Glass-Mat Backer Material shall score a rating of 10 when tested according to ASTM D 3273. Thickness as shown on the Drawings. Provide Type X where required as shown on Drawings. Provide one of the following products:
1. GlasRoc Tilebacker by Certaineed.
 2. DensShield Tile Backer by Georgia Pacific.
 3. GreenGlass Tile Backer by Temple-Inland.
 4. Gold Bond e²XP Tile Backer by National Gypsum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions and adjacent areas where products will be installed and verify that conditions conform to product manufacturer's requirements. Verify that building framing components are ready to receive Work. Verify that rough-in utilities are in-place and located where required. Do not proceed until unsatisfactory conditions have been corrected.
- B. Examine panels to assure they are dry and free of moisture and mold damage as evidenced by discoloration, sagging, irregular shape, fuzzy or splotchy surface contamination, and discoloration.

- C. Beginning of erection and installation indicates acceptance of existing conditions.

3.2 INTERFACE WITH OTHER WORK

- A. Coordinate erection of studs with hollow metal door and window frames, sliding window, and overhead coiling door frames.
- B. Coordinate installation of anchors, supports, and blocking for mechanical, electrical, and building accessory items installed within framing.

3.3 INSTALLATION - STEEL FRAMING, GENERAL

- A. Installation Standards: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation and with further details and instruction by gypsum board manufacturer's written construction guidelines.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply, if none available, with United States Gypsum's "Gypsum Construction Handbook."

3.4 INSTALLATION - PARTITION FRAMING

- A. Install studs and fasteners in accordance with manufacturer's published instructions, ASTM C 754, GA-216, and GA-600.
- B. Install bracing at terminations in assemblies.
- C. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- D. Install studs so flanges within framing system point in same direction.
- E. Metal Stud Spacing: Unless otherwise noted on Drawings, provide interior framing at maximum spacing specified herein at 2.2C. Provide spacing of 16 inches on center maximum for walls to receive ceramic tile.
- F. Align stud web openings horizontally.
- G. Splice studs with minimum 8 inch nested lap, fasten each stud flange with minimum two screws.
- H. Construct corners using minimum three studs.
- I. Place studs as indicated on Drawings, minimum 2 inches from abutting walls.
- J. Install framing between studs for attachment of mechanical and electrical items.
- K. Install intermediate studs above and below openings to match wall stud spacing.
- L. Install tracks (runners) at floors and overhead supports. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through ceiling to building structure above.
- M. Maintain clearance under structural members to avoid deflection transfer to studs.
 - 1. Where indicated, construct partition to accommodate vertical deflection.
 - 2. Install optional products specified in Part 2 above in accordance with manufacturer's printed instruction.
 - a. Install clip with step bushing in center of slotted hole.
 - b. Use a minimum of two fasteners per clip leg to connect clip to structure and partition framing.
 - c. Attach clip to each stud by screwing through the center of each step bushing.

- N. Fasten studs adjacent to door and window frames, partition intersections, and corners to top and bottom runner flanges in double-stud fashion with metal lock fastener tools.
1. Securely fasten studs to jamb and head anchor clips of door and borrowed-light frames.
 2. Place horizontally a cut-to-length section of runner with web-flange bend at each end, fasten with minimum one screw per flange.
 3. Position a cut-to-length stud (extending to top runner) at vertical panel joints over door frame header.
- O. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
- P. Lateral Bracing for Metal Studs:
1. In metal stud partitions and bulkheads where length of metal studs is over 8 feet, install lateral bracing using one of the following methods:
 - a. Install 1-1/2 inch cold-formed channel through stud web holes and screw attach in place with clip angles. Lap channels by nesting one inside the other to a depth of at least 8 inches and wire tie together.
 - b. Install optional products specified in Part 2 above in accordance with the manufacturers printed instructions.
 - c. Install field-cut runner for solid bridging at each end of wall, adjacent to wall openings, and 10 feet on center maximum. Install 1-1/2 inch wide, 20 (30 mil) gage strap bracing on both sides of stud. Fasten strap bracing to each solid bridging runner section with four screws.
 2. Gypsum Board Partitions: Space lateral bracing at the following intervals:
 - a. Partitions sheathed with gypsum board full height, each side: Provide bracing at mid-height.
 - b. Partitions sheathed with gypsum board partial height (one or both sides): Provide bracing at 48-inches on center for unsheathed height of partition.
 3. Wire Mesh Partitions: Space lateral bracing at the following intervals:
 - a. Stud Length Greater Than 8 Feet: Provide bracing at 60-inches on center.
- Q. Install braced framing of steel stud framing as indicated on Drawings. Use only screw attachments.
- R. Blocking: Screw attach wood blocking between studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories and hardware.
- S. Framing Fastening: Fasten framing in accordance with manufacturer's published instructions and schedule below, unless indicated otherwise on Drawings.

Connection	Fastener
Floor Track to Concrete	1 - Pin at 32 inches on center
Partition Stud to Floor Track	1 - Screw each side at each flange
Stud Brace Web to Stud Web	2 - Screws
Plates and Straps to Studs	2 - Screws
Stud Web to Stud Web	2 - Screws
Stud Brace Web to Attachment Angle	2 - Screws
Lateral Bracing to Partition Stud Using Clip Angles	2 - Screws to stud and 2 - Screws to cold rolled channel
Runner to Header	1 - Screw at 16 inches on center, maximum 6 inches from each end

3.5 INSTALLATION - FURRING

- A. Furring Channels:
1. Attach vertically spaced at maximum 16 inches on center, to masonry and concrete surfaces with hammer set or powder driven fasteners staggered 24 inches on center on opposite flanges.
 2. Nest channels 8 inches at splices and anchor with 2 fasteners in each wing.
- B. Wall Furring:
1. Secure top and bottom runners to structure.
 2. Space metal studs at maximum 16 inches on center.

3. Furring for Fire Rating: Install metal furring as required for fire resistance ratings indicated on Drawings, and to GA-600 requirements.

3.6 INSTALLATION - ACOUSTICAL INSULATION

- A. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions as specified in Section 07210 where shown on Drawings.

3.7 INSTALLATION - GYPSUM BOARD

- A. Install gypsum board in accordance with manufacturer's published instructions, ASTM C 840, GA-216, and GA-600.
 1. Use water resistant gypsum board at wet areas including walls and ceiling in toilet rooms, janitor closets, and food prep areas as applicable and where shown.
 2. Use fire resistant gypsum board at locations of fire-resistive rated assemblies indicated on Drawings.
 3. Use water and fire resistant gypsum board at locations of fire-resistive rated assemblies where water resistant gypsum board is specified.
 4. Use standard gypsum board at locations not indicated to be fire resistant or water resistant type.
- B. Use proper dust control tools and methods when scoring, breaking, and otherwise handling gypsum board.
- C. Where applicable, install ceiling panels before the installation of wall panels.
- D. Erect single layer gypsum board in most economical direction in accordance with ASTM C 840, with attachment to firm bearing surfaces over framing members. Do not align panel joints with edges of openings.
- E. Double Layer Applications: Secure second layer to first with screws; apply second layer with screws, staggering joints with those of first layer. Use adhesive only to hold second layer until screwed in place. Use fire rated gypsum backing board for fire rated partitions.
- F. Treat cut edges, holes, fastener heads, and joints, including those at angle intersections, in water resistant gypsum board with specified joint compound. Treat prior to installation.
- G. Place gypsum panels over supporting framing members with panel ends aligning and parallel with framing members. Leave bottom edge spacing above floor in accordance with GA-216.
- H. Install fasteners spaced and located in accordance with GA-216 or ASTM C840.

3.8 INSTALLATION - BACKER MATERIALS

- A. Install glass-mat backer materials where indicated to receive glass-mat backer material. Install in accordance with manufacturer's instructions.

3.9 INSTALLATION - JOINT TREATMENT

- A. Install joint treatment in accordance with GA-216.
- B. Install corner bead, trim, and casing in accordance with GA-216.
- C. Install control joints full height of partition with 1/2 inch gap between board edges and between studs. Control joints shall be installed in accordance with the gypsum manufacturer's recommended guidelines for control joints or the Gypsum Association GA-234 for control joint in fire rated systems. Apply sealant at base of joint and control joint accessory piece at face. Install control joints at the following locations:
 1. Where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
 2. At pairs of doors, install vertical control joint at each jamb. At single doors, install control joint at latch side of jamb.

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3.10 FINISH

- A. Apply gypsum board finish in accordance with manufacturer's published instructions and GA-214 Finish Levels.
- B. Provide gypsum board finish levels at locations as follows:
 - 1. Level 1 (GA-214): Joints and interior angles have tape embedment set in joint compound. Surface free of excess joint compound. Tool Marks and ridges are acceptable.
 - a. Areas above ceilings where required by drawings.
 - b. Concealed areas.
 - c. Interior exposed gypsum surfaces not indicated to be painted.
 - 2. Level 2 (GA-214): All joints and interior angles have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories are applied with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - a. Areas receiving tile and not exposed to view and where required by drawings.
 - 3. Level 3 (GA-214): Joints and interior angles have tape embedded in joint compound and one additional coat of joint compound applied over all joints and interior angles and two separate coats of joint compound are applied over joints, angles, fastener heads, and accessories. Surface smooth and free of tool marks and ridges.
 - a. Areas receiving FRP
 - 4. Level 4 (GA-214): Joints and interior angles have tape embedded in joint compound and immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound are applied over joints and interior angles. Fasteners and accessories are applied with three separate coats of joint compound. Surface smooth and free of tool marks and ridges.
 - a. Interior gypsum surfaces indicated to be painted.

3.11 FIELD QUALITY CONTROL

- A. Inspect metal framing erection, placement, spacing, fasteners, and connections to building.
- B. Inspect gypsum board installation, fastener type, spacing, and finish level.
- C. Inspect installation of firestopping penetrations of fire-restive rated partitions and at voids between top of partition and building structure.
- D. Correct deficiencies in Work which inspection indicates are not in compliance with Contract Documents.

3.12 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces.
- B. Protect installed interior non load-bearing steel stud partition framing, gypsum board, and backer materials from damage until Substantial Completion.

END OF SECTION

SECTION 09310 - CERAMIC TILE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic wall tile, floor tile, and accessories.
- B. Related Requirements: The following list is intended to aid in locating work related to or dependent on the scope of Work in this Section. The list is included for information only and is not intended to be inclusive of all project requirements.
 - 1. Section 01351 – Regulatory Compliance.
 - 2. Section 01600 - Product Requirements: Contractor’s Product Lead Time Schedule.
 - 3. Section 07900 - Joint Sealers: Sealant at tile penetrations and control/construction joints.
 - 4. Section 09250 - Gypsum Board Systems: Wall tile substrate.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A108/A118/A136.1 – Specifications for the Installation of Ceramic Tile.
 - a. A108 – Installation Standards:
 - 1) .02 – General Requirements: Materials, Environmental, and Workmanship.
 - 2) .5 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
 - 3) .15 – Alternate Method: Installation of Paper-Faced Glass Mosaic Tile.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.
- D. Tile Council of America, Inc. (TCA):
 - 1. TCA Handbook for Ceramic Tile Installation.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions or provide equipment that suppresses dust.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Product Requirements: Transport, Handle, Store, and Protect Products.
- B. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- C. Store packaged materials in original containers with seals unbroken and labels intact until time of use.
- D. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.5 SITE CONDITIONS

- A. Do not install adhesives in a closed, unventilated environment.
- B. Maintain 50 degrees F during installation of mortar materials.

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PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide products by the following manufacturers to the extent specified hereinafter:
1. Dal-Tile Corporation, Dallas, TX, (214) 398-1411.
 2. Laticrete International, Bethany, CT. (800) 243-4788.
 3. Pemko (ASSA ABLOY):
 - a. West Coast: Ventura, CA (800) 283-9988.
 - b. East Coast: Memphis, TN (800) 824-3018.
 4. Schluter Systems, Plattsburg NY. Contact: Earl Maicus (800) 267-0817 Ext. 3410.

2.2 SUPPLIERS

- A. Specified ceramic tile products may be procured from the following suppliers.
1. Haines, Jones & Cadbury (HJC). Contact: Customer Service (800) 459-7099, WMT@hjcinc.com
 2. Products may be procured from distributor or supplier listed on tile manufacturers' website.
- B. Specified mortar, grout and other setting materials may be procured from the following suppliers:
1. Haines, Jones & Cadbury, Inc., Bentonville, AR, Customer Service (800) 459-7099, WMT@hjcinc.com
 2. The Home Depot.
 3. Koffler Sales Company, Lake Zurich, IL, (888) 727-5102.
 4. The Corner Guard Store, (800) 516-4036.
 5. Schluter Systems; Contact manufacturer at (800) 267-0817 for list of distributors.

2.3 CERAMIC TILE

- A. Provide Standard grade tile that complies with ANSI A 137.1 for types, compositions, and other characteristics indicated.
1. CT-3 (Grey):
 - a. Portfolio, 12x24, Ash Grey PF05, Unpolished, by Daltile.
 2. CT-4 (Grey):
 - a. Delegate, 3x24 base, Dark Grey DL27, Unpolished, by Daltile.
 3. CT-5 (Grey):
 - a. Delegate, 12x24, Dark Grey DL27, Unpolished, by Daltile.

2.4 SETTING MATERIALS

- A. Thin-Set Mortar: Multi-use, polymer fortified adhesive mortar for wall installations and as medium bed mortar for flooring installations:
1. 4-XLT, by Laticrete.
- B. Grout: SpectraLOCK PRO Grout, by Laticrete.
1. G-4 (Taupe): Dusty Grey #60.
- C. Grout Cleaning Additive: LATICRETE SpectraLOCK PRO Cleaning Additive.
- D. Floor Leveling Compounds and Primer:
1. Laticrete NXT Level Plus Self Leveling Underlayment by Laticrete.
 2. NXT Primer for Underlayment by Laticrete.

2.5 TRIM UNITS

- A. Stainless Steel Top and Corner Trim - C: Rondec RO, stainless steel, by Schluter.
1. Connector: V/RO, stainless steel, by Schluter.
- B. Stainless Steel Vertical Outside Corner Trim: Rondec EV/RO, stainless steel, by Schluter.

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- C. Stainless Steel Horizontal Inside Corner Trim: Rondec ID/RO, stainless steel, by Schluter.
- D. Stainless Steel Vertical Inside Corner Trim: Dilex EHK U11/011, stainless steel, by Schluter.
- E. Stainless Steel Corner Guard - A: Specified in Section 10260.
- F. Tile Edge Transition - D: Schluter Schiene, stainless steel, by Schluter.
- G. Stainless Steel Corner Trim - B: One of the following:
 - 1. ECK-K, 1-1/2 x 1-1/2, K32 V2A/200 with anchoring leg, stainless steel, by Schluter.
- H. Stainless Steel Trim Installation Accessories: Schluter ProCut Cutting Wheel #TSM 115/1, by Schluter.
- I. Transition Strips:
 - 1. Transition edge strip between concrete slab and ceramic tile: No. 8136 by National Guard Products, Inc., or equivalent by Pemko or Reese. 1-1/8"x 1/4" aluminum, smooth surface, beveled 1 side only.
 - 2. Transition edge strip between concrete slab and ceramic tile: Reno Ramp AERP-125B90 by Schluter Systems, Plattsburgh, NY. 3-1/2" x 1/2" satin anodized aluminum sloped transition ramp.
 - 3. Transition edge strip between concrete slab and flooring panels: Reno Ramp/-K by Schluter Systems, Plattsburgh, NY, satin anodized aluminum sloped transition ramp.
 - 4. Splashguard for showers: Showerprofile-WS+-WSL by Schluter Systems, Plattsburgh, NY, satin anodized aluminum support profile with straight lip insert as shown on Drawings.

2.6 MORTAR MIX AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers for proportioning of materials, water or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, and mixing time to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

2.7 DUST EXTRACTION SYSTEM AND PRE-SEPARATOR

- A. Provide dust extraction system and pre-separator for use during mechanical slab preparation where required or specified.
 - 1. Heavy-duty industrial HEPA filtration vacuum system, suitable for extracting and containing large quantities of fine concrete dust (minimum 350CFM air flow) in conjunction with manufacturer recommended pre-separator.
 - 2. Provide one of the following:
 - a. 86D, by HTC.
 - b. T8600, by Pullman-Ermator.
 - c. Bull 1250, by SASE Company, Inc.
 - d. Approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas where products will be installed and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of installation indicates acceptance of substrate conditions.

3.2 PREPARATION

- A. Protect surrounding work from damage or disfiguration.

- B. Interior Concrete Slab:
 1. Vacuum clean existing substrate and damp clean.
 2. Seal substrate surface cracks with filler.
 3. Level existing substrate surfaces in accordance with TCA installation requirements and remove peaks or valleys using floor leveling compound specified. Prime, clean and prepare concrete surface as required by manufacturer and apply leveling compound in accordance with manufacturer's instructions.
- C. Prepare substrate surfaces which do not need joint repair with sealers or conditioners as recommended by adhesive manufacturer.

3.3 INSTALLATION

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials shown and specified.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with applicable TCA installation methods.
- C. Transition Strip: Install transition strip at transitions between ceramic tile and concrete. Install during tile placement in accordance with edge strip manufacturer's instructions.
- D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- E. Cut tile using saws equipped with integrated water delivery system that continuously feeds water to the blade.
- F. Fit tile tight to penetrations. Form corners and bases neatly. Align floor and base joints.
- G. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Expansion Joints: Provide tile expansion joints at control/construction joints in concrete slab. Keep joints free of mortar or grout.
 1. Installation Method: TCA EJ171.
- J. Allow tile to set for a minimum of 48 hours prior to grouting.
- K. Grout tile joints.
 1. Grout space shall be 1/8-inch for all tile joints unless otherwise noted on Drawings.
- L. Apply sealant to junction of tile and dissimilar materials, at tile penetrations, and at tile expansion joints.

3.4 FIELD QUALITY CONTROL

- A. Inspect ceramic tile installation, joints, grout line alignment, and attachment to substrate.
- B. Correct deficiencies in Work which inspection indicates are not in compliance with Contract Documents.

3.5 CLEANING

- A. Remove excess mortar and grout from floor, base, and wall surfaces without damage.
- B. On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Initially clean and remove grout residue from tile as soon as possible according to tile and grout manufacturer's written instructions. Use cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned.

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- Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
2. Begin final cleaning approximately 1 hour after initial cleaning of the grout. Mix cleaning additive to 2 gallons of clean, cool water. Use a white scrub pad to lightly scrub apart any of the leftover residue remaining on the surface of the tile. Drag a clean, damp sponge diagonally over the scrubbed surfaces to remove any froth and residue. Rinse sponge often and change water every 50 square feet of surface. Allow cleaned areas to dry and inspect entire surface of tile. Repeat if haze remains.
 3. If haze remains 24 hours after installation, clean surfaces using straight white vinegar or bleaching type cleanser by methods described in preceding paragraph.
- C. Dispose of construction waste in accordance with the requirements of Section 01351.
- D. Perform final cleaning of tile with cleaning materials recommended by tile manufacturer one day prior to Date of Substantial Completion.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit traffic from floor finish for 72 hours after installation.

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END OF SECTION

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SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Suspended metal grid ceiling system.
 - 2. Acoustical panels.
 - 3. Perimeter trim.

- B. Related Requirements:
 - 1. Section 01351 - Regulatory Compliance: References to Contract Provisions for removal and recycling of acoustical ceiling tile.
 - 2. Section 13900 - Fire Suppression: Sprinkler heads in ceiling system.
 - 3. Section 15800 - Air Distribution: Air diffusion devices in ceiling system.
 - 4. Section 16500 - Lighting: Light fixtures attached to ceiling system.
 - 5. Appendix B – Testing, Inspection and Observation by Owner: Procedures for inspection, testing, and documentation by Owner furnished testing laboratory.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are reference within the text by these basic designations only.

- B. ASTM International (ASTM):
 - 1. ASTM C 635 - Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 2. ASTM C 636 - Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 3. ASTM C 1858 – Direct Hung Suspended T-bar Type Ceiling Systems Intended to Receive Gypsum Panel Products in Areas Subject to Earthquake Ground Motions.
 - 4. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 5. ASTM E 580 - Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 - 6. ASTM E 1264 - Acoustical Ceiling Products.

- C. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 01330.

- B. Product Data. Provide manufacturer's product data for suspension systems, showing all components.

- C. Shop Drawings: Show the following:
 - 1. Layout of grid components and hanger spacing, including perimeter support wires.
 - 2. Locations and methods of attachment of grid to walls. Clearance where grid is not attached to walls.
 - 3. Connection of ends of main beams and cross tees.
 - 4. Locations and details of compression struts and horizontal restraint wires or rigid bracing.
 - 5. Locations and details of seismic separation joints.
 - 6. Bracing for changes in ceiling plane.
 - 7. Locations and support details for light fixtures, diffusers, and other items within the ceiling system.

- D. Evaluation Report: ICC-ES report verifying code compliance for systems with alternative materials, design or methods of construction not specifically prescribed by the building code.

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Rigidly secure acoustical ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect products.
- B. Deliver acoustical units in manufacturer's original unopened containers with brand name and type clearly marked.
- C. Store under cover in dry, watertight conditions.
- D. Prior to installation, store acoustical units for 24 hours minimum at same temperature and relative humidity as space where Work will be installed.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain uniform temperature range of 60-85 degrees F, and humidity of no more than 70 percent relative humidity prior to, during, and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products by the following manufacturers as specified:
 - 1. Armstrong World Industries Incorporated, Lancaster, PA (800) 448-1405.
 - 2. CertainTeed Ceilings, Valley Forge, PA (800) 233-8990.
 - 3. [Rockfon](#), LLC (Formerly Chicago Metallic Corporation), Chicago, IL (800) 323-7164.
 - 4. Gold Bond Building Products, National Gypsum Company, Charlotte, NC (704) 365-7300.
 - 5. USG Interiors, Chicago, IL (800) 950-3839.

2.2 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics in Accordance with ASTM E 84 for Class A finish:
 - 1. Flame Spread: Less than 25.
 - 2. Smoke Density: Less than 50.
- B. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE 7.
- C. Food Serving and Preparation Areas where Scheduled:
 - 1. United States Department of Agriculture (USDA): Approved for incidental food contact.

2.3 SUSPENSION SYSTEM

- A. Provide suspension system specified herein for the corresponding ACT system as applicable as shown on the drawings. Provide suspension system compatible with acoustical panels selected.
- B. Grid: ASTM C635, heavy duty, steel exposed T; nominal 1 inch width; stab-in connections.
- C. Accessories: Stabilizer bars (Cat D, E, and F only), clips, and splices.

- D. Grid Finish:
 1. White, unless noted otherwise.
- E. Support System: Hot or cold rolled steel channels; galvanized hanger wire, minimum 12 gage.
- F. Edge Moldings: Metal channel with exposed flange to match suspension system.
 1. Minimum 2 inch wide horizontal leg.
- G. Compression Struts: Telescoping compression strut designed to attach to main tees at each splayed wire location, preventing upward movement of ceiling grid system. Provide either of the following:
 1. Donn Compression Post, by USG.
 2. Field fabricated compression struts as detailed on drawings.
- H. ACT-1; Non Fire-Rated Suspension System: Provide one of the following:
 1. Prelude 15/16 inch, XL #7300 Exposed Tee System, by Armstrong.
- I. ACT-2; Fire Rated - USDA Approved Suspension System: Provide one of the following:
 1. Prelude Plus Fire Guard, XL, HDA8200, by Armstrong.
 2. Environmental HDG Steel System, 1830 Fire Front, by Rockfon.
 3. Environmental System ZXLA, by USG.
- J. ACT-3 (**Black**); Non Fire-Rated Suspension System: Provide one of the following:
 1. Prelude 15/16 inch, XL #7300 Exposed Tee System, by Armstrong.
- K. Substitutions: Not Permitted.

2.4 ACOUSTICAL LAY-IN PANELS:

- A. Provide acoustical panels specified herein for the corresponding ACT system as applicable as shown on the drawings.
- B. ACT-1: Non Fire-Rated Panels, square edge, nonperforated, abuse-resistant vinyl film facing, size as shown. Provide one of the following:
 1. Cortega, 2' x 4', white, square edge, by Armstrong.
- C. ACT-2: Square edge, non-perforated vinyl-faced gypsum panels, which satisfy USDAFSSIS guidelines for sanitary applications. Size as shown. Provide one of the following:
 1. VinylRock, by CertainTeed.
 2. Sheetrock Lay-in Ceiling Panel ClimaPlus, by USG.
 3. Gridstone Brand Gypsum Ceiling Panels, by National Gypsum.
- D. ACT-3 (**Black**): Non Fire-Rated Panels, square edge, nonperforated, abuse-resistant vinyl film facing, size as shown. Provide one of the following:
 1. Cortega, 2' x 4', black, square edge, by Armstrong.
- E. Substitutions: Comply with the requirements of Section 01600.

PART 3 - EXECUTION

3.1 PREPARATION/DEMOLITION

- A. Examine surfaces and adjacent areas where products will be installed and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.
- B. Verify that layout of hangers will not interfere with other Work.

- C. Beginning of installation indicates acceptance of conditions.

3.2 INSTALLATION – GENERAL

A. Interface with Other Work:

1. Do not install acoustical ceilings until building is enclosed, heating is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
2. Schedule installation of acoustic units after interior wet work is completed.
3. Install after major above ceiling work is complete.
4. Coordinate location of hangers with other Work.

B. Site Tolerances:

1. Variation from Flat and Level Surface: 1/8 inch in 12 feet.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install System in accordance with ASTM C 636, ASTM E 580, ASCE 7 and manufacturer's published instructions.
- B. Rigidly secure acoustical ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.
- C. If metal deck is not supplied with hanger tabs, coordinate installation of hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- D. Hang system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
- E. Locate system on room axis to a balanced grid design with edge units no less than 50 percent of acoustical panel size where Reflected Ceiling Plan not shown on Drawings.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Do not eccentrically load system, or produce rotation of runners.
- G. Install edge molding at intersection of ceiling and vertical surfaces using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions. Secure at 16 inches on center.
- H. Install compression struts and secure system with tie wires.
 1. Unless otherwise indicated on Drawings, provide four 12 gage wires secured to main runner within 2 inches of cross runner intersection and splayed 90 degrees from each other at angle not exceeding 45 degrees from plane of ceiling.
 2. Fasten strut to main runner, extend to and fasten to structural member supporting roof.
 3. Locate compression strut and splayed hanger wires at a maximum of 12-feet on center in both directions with first point within 6-feet from each partition.
 4. Fasten runner ends to perimeter enclosure on two adjacent walls.
 5. Do not fasten runners on two opposite ends and provide 3/4" clearance to vertical leg of perimeter enclosure.
 6. Prevent all terminal ends of runners not directly attached to perimeter enclosure from spreading.

3.4 INSTALLATION - ACOUSTICAL PANELS

- A. Fit acoustic units in place free from damaged edges or other defects. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
- B. Within any enclosed room, do not mix panels of different brands.

3.5 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except as specified as mandatory, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not preclude Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.6 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection as specified in Appendix B (Section 09511).

3.7 CLEANING

- A. Clean exposed surfaces of acoustical ceilings including trim, edge moldings, and suspension system members

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END OF SECTION

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SECTION 09655 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rubber or Vinyl Resilient Base (RB).
 - 2. Resilient Stair Treads and Accessories.
- B. Related Requirements:
 - 1. Section 01600 - Product Requirements: Contractor's Product Selection Checklist.
 - 2. Section 07900 – Joint Sealers: Sealant between bases and floor or wall surfaces.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Surface Burning Characteristics of Building Materials.
 - 2. ASTM F 710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - 3. ASTM F 1861 – Resilient Wall Base.
 - 4. ASTM F 2169 - Standard Specification for Resilient Stair Treads.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Resilient Base:
 - 1. Armstrong Flooring, Lancaster, PA, (888) 276-7876.
 - 2. Flexco, Corp., Tuscumbia, AL, (800) 633-3151,
 - 3. Johnsonite, Solon, OH, (800) 899-8916.
 - 4. Roppe Rubber, Fostoria, OH (800) 537-9527.
 - 5. VPI Corp., Sheboygan, WI, (800) 874-4240
- B. Transition Strips:
 - 1. National Guard Products, Memphis, TN, (800) 647-7874.
 - 2. Ceramic Tool Company, Pewaukee, WI, (800) 236-5230.
 - 3. (Fasteners only) Hilti, (800) 879-8000.
- C. Resilient Stair Treads:
 - 1. Nora Systems, Inc., Salem, NH 03079 (603) 894-1021.
- D. Adhesives:
 - 1. Seal Bond, Spring Lake, MI, (800) 252-4144.
 - 2. Franklin International, Columbus, OH, (800) 877-4583.

2.2 SUPPLIERS

- A. Specified products may be procured from the following suppliers.
1. Haines, Jones & Cadbury. Contact: Customer Service (800) 459-7099, WMT@hjcinc.com
 2. B.R. Funsten & Co, Fairfield, CA, (800) 479-5671.
 3. J.J. Haines and Co., Glen Burnie, MD, (800) 922-9248.
 4. T & A Supply Co., Kent, WA (800) 562-2857.
 5. T & L Distributing, Houston, TX (800) 888-0601.
 6. Contact specified manufacturers for additional distributors.

2.3 RESILIENT BASE

- A. Resilient Base: In accordance with ASTM F 1861, color integrated Type TV (vinyl), TS (rubber, vulcanized thermoset), or TP (rubber, thermoplastic); 1/8 inch thickness unless noted otherwise, approximately 4 inches high. Provide matching end stops and preformed corner units where required, unless noted otherwise. Verify color prior to ordering.
1. RB1 – Black:
 - a. [Armstrong](#) Vinyl or Rubber: No. 60 Jet Black.
 - b. [Flexco](#) Rubber: No. WF-01 Black Dahlia.
 - c. [Johnsonite \(Tarkett\)](#) Vinyl or Rubber: No. 40 Black.
 - d. [Roppe](#) Vinyl or Rubber: No. 100 Black.
 - e. [VPI](#) Vinyl or Rubber: Jet.
- B. Resilient Base Accessories:
1. Adhesive: Water resistant type, VOC less than 50 g/l. Provide GREENchoice Professional Cove Base Adhesive, by Franklin International or equivalent product by another manufacturer.

2.4 RESILIENT STAIR TREADS

- A. One-Piece Nosing, Tread and Riser: Manufactured in accordance with ASTM F 2169, Type TS
1. Surface Design: Raised round pastilles.
 2. Color: R1 (Gray) – Stone Gray, by Nora Systems, Inc.
 3. Installation Tape: Nora Stepfix.
 4. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- B. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Resilient Stair Treads:
1. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
 2. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - d. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 3. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
 4. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - a. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.2 INSTALLATION

A. Resilient Base:

1. Install base in accordance with manufacturer's requirements using manufacturer's approved adhesive.
2. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints. Use premolded corner units.
3. Install base on solid backing. Bond tight to wall surfaces.
4. Scribe to fit door frames and other interruptions.
5. Remove excess adhesive from floor, wall surfaces and base.

B. Resilient Stair Treads: Install resilient stair treads in accordance with manufacturer's written instructions.

3.3 CLEANING

- #### A. Remove excess adhesive from floor, base, and wall surfaces without damage.

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SECTION 09722 - PRESENTATION DRY-ERASE WALLCOVERING

PART 1 – GENERAL

1.1 SUMMARY

- A. Division Includes:
 - 1. Dry Erase Wallcovering.
 - 2. Tray, Trim, and Presentation Rails.
 - 3. Accessories.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. E84 Test Method for Surface Burning Characteristics of Building Materials.
- B. Gypsum Association:
 - 1. GA-214-M-97 Recommended Levels of Gypsum Board Finish.

1.3 SUBMITTALS

- A. Manufacturer's product data and installation instructions for each type of dry erase wallcovering, adhesive, and accessories required.
- B. Manufacturer's written product data indicating compliance with specified materials required.
- C. Manufacturer's written installation instructions.
- D. Manufacturer's written instructions for recommended maintenance of each type of dry erase wall covering required.
- E. Samples:
 - 1. 7 inch (177.8mm) x 9 inch (228.6mm) samples of each dry erase material required.
 - 2. 6 inch (152.4mm) samples of trim, tray, and end caps required.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide each type of dry erase wallcovering required produced by one manufacturer.
- B. Installer: Installation by skilled commercial wallcovering contractor with no less than three years of documented experience installing dry erase wallcovering of the types and extent required.
- C. Composition:
 - 1. EZ-Rite®: Provide non-woven backing, white pigmented vinyl capped with high-gloss, dry erase film.
- D. Surface Burning Characteristics Classification: Provide materials that meet Class I/A rating when tested in accordance with ASTM E84 for flame spread and smoke developed
- E. Field Samples: Prepare field samples for architect's review and establish requirements for seaming and finish trim.
 - 1. Install sample panel of each type presentation wallcovering specified in area designated by architect.
 - 2. Maintain corrected and approved samples to serve as a standard of performance for the project.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver presentation wallcoverings to the project site in unbroken and undamaged original factory packaging and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.
- B. Store materials in a clean, dry storage area with temperature maintained above 55°F (13°C) with normal humidity.
- C. Store material within original packaging to prevent damage.

1.6 PROJECT CONDITIONS

- A. Do not apply presentation wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.
- B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55°F (13°C) unless required otherwise by manufacturer's instructions.
- C. Apply adhesive when substrate surface temperature and ambient temperature is above 55°F (13°C) and relative humidity is below forty percent.
- D. Maintain constant recommended temperature and humidity for at least 72 hours prior to and throughout the installation period, and for 72 hours after wallcovering installation completion.
- E. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.7 WARRANTY

- A. Submit manufacturer's limited ten-year written warranty against manufacturing defects.

1.8 MAINTENANCE

- A. Maintenance instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Wallcoverings: Walltalkers Wallcoverings manufactured by Koroseal Interior Products, LLC., Fairlawn, Ohio.

2.2 MATERIALS

- A. Walltalkers EZ-Rite: Non-woven backing, white pigmented vinyl capped with high-gloss, dry erase film
 - 1. ZP50: 49/50 inch (1.25/1.27m) width, non-woven backing.

2.3 TRIM & TRAY

- A. J Cap Wallcovering Trim:
 - 1. JC12-00: Clear satin, anodized aluminum, low profile trim

2.4 ACCESSORIES

- A. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214-M-97: Recommended Levels of Gypsum Board Finish, and permanent lighting should be installed and operational.
- B. Test substrate with suitable moisture meter and verify that moisture content does not exceed four percent.
- C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
- D. Evaluate all painted surfaces for the possibility of pigment bleed-through.
- E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- F. Beginning of installation means acceptance of surface conditions.

3.2 INSTALLATION Wallcovering backing.

- A. Acclimate wallcovering in the area of installation a minimum of 24 hours before installation.
- B. Read and follow the manufacturer's installation instruction sheet contained in each roll of the dry erase wallcovering.
- C. Examine all materials for pattern, color, quantity and quality, as specified for the correct location prior to cutting.
- D. Primer: Use a quality pigmented acrylic wallcovering primer.
- E. Adhesive: Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.
- F. Install each strip horizontally and in the same sequence as cut from the roll.
- G. Install dry erase wallcovering sheets in exact order as they are cut from bolt. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.
- H. Install dry erase wallcovering horizontally using a level line.
- I. Using a level or straight edge, double cut the seam with a seam-cutting tool (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material.
- J. When covering the entire wall, seam the material out of the main writing and viewing areas of the wall.
- K. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.
- L. Remove excess adhesive immediately after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.

- M. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.3 CLEAN-UP

- A. Upon completion of installation, remove all exposed adhesive immediately using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.
- B. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.

END OF SECTION

SECTION 09900 - PAINTS AND COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Field applied paints and finishes for interior and exterior surfaces.
 - 2. Application of new coatings.
- B. Related Requirements:
 - 1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of hazardous construction and demolition waste.
 - b. Work practice control methods for airborne respirable dust.
 - 2. Section 07900 - Joint Sealer

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM D 1653 – Standard Test Methods for Water Vapor Transmission of Organic Coating Films (Wet Cup Method).
 - 2. ASTM D 2244 – Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 3. ASTM D 2370 – Standard Test Method for Tensile Properties of Organic Coatings.
 - 4. ASTM D 3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings.
 - 5. ASTM D 3359 – Measuring Adhesion by Tape Test.
 - 6. ASTM D 4214 – Evaluating the Degree of Chalking of Exterior Paint Films per Method A Cloth Tape Method
 - 7. ASTM D 4262 – Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - 8. ASTM D 4263 - Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 9. ASTM D 6677 – Test Method for Evaluating Adhesion by Knife.
 - 10. ASTM D 6904 – Resistance to Wind-Driven Rain.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.
- D. The Society for Protective Coatings (SSPC):
 - 1. SSPC-SP1 – Solvent Cleaning.
 - 2. SSPC-SP3 – Power Tool Cleaning.
 - 3. SSPC-SP15 - Commercial Grade Power Tool Cleaning.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.
- B. Apply paint to concrete surfaces only when moisture content is within manufacturer's acceptable range as described in Part 3 herein for type of specified coating.
- C. Maintain minimum surface temperatures or ambient air temperature as follows for the specified coatings unless otherwise recommended by the manufacturer or specified in the Paint Schedule herein:
 - 1. Alkyd, epoxy, polyurethane, and interior and exterior acrylic and latex finishes: 50 degrees F.
 - 2. Varnish and transparent finishes: 65 degrees F.
 - 3. All coatings: Surface temperature at least 5 degrees F above the dew point.

- D. Maintain maximum surface temperatures or ambient air temperatures and relative humidity as recommended by the manufacturer.
- E. If ambient temperatures are unacceptable, provide continuous ventilation and heating facilities to maintain temperatures above the minimum surface and air temperature specified above for 24 hours prior to, during, and 48 hours after application of finishes.
- F. If work area is enclosed, use fire retardant enclosure materials and indirect-fired heating equipment ventilated outside of the enclosure.
- G. Do not apply paint in areas where dust is being generated. Do not apply coatings in conditions that could result in overspray on vehicles or other property.
- H. Perform painting under lighting conditions of not less than 80 foot candles measured mid-height of the painter at substrate surface. Where artificial lighting is required, provide explosion-proof artificial lighting.
- I. Waste Management:
 - 1. Store, transport, and dispose of waste in accordance with local, state and federal regulations and the requirements of Section 01351 Supplement.
 - 2. Do not dispose of paint, containment materials, or project waste in Owner's dumpsters.
 - 3. Do not allow dry materials to enter storm drain inlets.
 - 4. Clear debris and waste from the site daily.
 - 5. Use HEPA-rated filter vacuum to clean surfaces of dirt, dust and debris.
 - 6. Obtain paint in containers of the largest size practical for each color, sheen, and type.
 - 7. Furnish disposal containers.
 - 8. Return reusable containers and totes to manufacturer.
 - 9. Clean and recycle containers that cannot be returned to manufacturer.
- J. Wastewater Management
 - 1. Collect wash wastewater and store, transport, manifest and dispose of according to local, state and federal regulations. Consult local wastewater treatment operator for direction.
 - 2. Do not allow wash wastewater to flow from the surface cleaning processes to a storm water drain or catch basin, street, roadway, sidewalk, gutter, landscape area, or any type of storm water structure.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling and Coordination:
 - 1. Scheduling requirements for Owner's independent and Manufacturer's Representative inspections is specified in Part 3 herein.

1.5 SUBMITTALS

- A. Closeout Documents:
 - 1. Submit closeout documents in accordance with Section 01770.
 - 2. Submit Manufacturer Inspection Report of post-installation site visit specified hereinafter.
 - 3. Photographic documentation: Upon Completion, submit a completion report including at least 10 wide-angle photos taken at work stages including but not limited to the following:
 - a. Before start of project.
 - b. During removal and replacement of sealants as specified in Part 3 herein.
 - c. During surface preparation of concrete and metal as specified in Part 3 herein.
 - d. During application of each coat, including spray and back roll application, as specified in Part 3 herein.
 - e. After completion of project.
 - f. Provide photos taken of each elevation from the same location in each work stage.
 - 4. Submit Manufacturer's Extended Material Performance Warranty and Contractor's Labor and Workmanship Warranty.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. VOC Content: Provide paint and coating materials that conform to Federal, State, and Local restrictions for Volatile Organic Compounds (VOC) content.
2. Toxicity/EQ: Comply with federal, state, and local toxicity and environmental quality regulations and with federal requirements on content of lead, mercury, and other heavy metals. Do not use solvents in paint products that contribute to air pollution.

B. Exterior Wall Coating Pre-Installation Conference:

1. Pre-Installation Conference:

- a. Plan and Convene a pre-installation conference to take place at the site one week prior to commencing Work of this Section. Confirm scheduling of conference with Owner's Construction Manager and Owner's Project Manager.
- b. At least two weeks in advance of the meeting, confirm scheduled time and place with all attendees. Make available the meeting agenda at the time of confirmation.
- c. Meeting Minutes:
 - 1) Record minutes of meeting including discussions, decisions and agreements reached, and attendance roster.
 - 2) Obtain signatures of all attendees.
 - 3) Furnish a copy to each party attending and to Owner's representatives.
- d. Attendance:
 - 1) Owner's Construction Manager.
 - 2) Owner's Project Manager or other Owner's authorized representative.
 - 3) Contractor.
 - 4) Coating subcontractor.
 - 5) Coating manufacturer's technical representative.
- e. Agenda:
 - 1) Substrate conditions, pre-installation testing results, and specified preparation requirements.
 - 2) Substrate preparation and repair details shown on drawings.
 - 3) Sequence and method of application of coating systems.
 - 4) Review of Coatings Systems Schedule, including Contractor's choice of exterior coatings systems where multiple manufacturers are listed as comparable.
 - 5) Review of Contractor's required photo documentation as specified herein.
 - 6) Scope of manufacturer's observations and reports.
 - 7) Manufacturer's performance warranty provisions.
 - 8) Workmanship warranty conditions.

C. Exterior Wall Coating Field Sample:

1. Test sample panel by applying exterior wall coating system 5 ft, 4 inches wide on full height of the wall at location on the building where shown on the drawings or established in the coating pre-installation meeting. Apply coating after the specified preparation and cleaning are completed.
2. Where more than one substrate preparation is recommended in a pre-installation assessment or shown on drawings, prepare sample panels using the coatings systems specified for each substrate condition.
3. Apply coatings in accordance with manufacturer's recommendations and specified colors, texture, workmanship, and application requirements.
4. Obtain approval of sample panel from the Owner's PM or other authorized inspection representative.
5. Maintain approved sample panel during construction as a standard for judging completed Work. Do not alter, move, or destroy panel until Work is completed.
6. Apply the scheduled final coat to the sample panel simultaneously with the application of the final coat to adjacent wall surfaces, resulting in the sample panel receiving one additional final coat.

D. Exterior Wall Coating Applicator Qualifications:

1. Contractor shall be solely responsible for the construction means, methods, techniques, sequences and procedures for completing the Work, shall be experienced in the preparation of surfaces and application of protective coatings to interior and exterior surfaces of in applications similar to this project.

- E. Independent Coatings Consultant (ICC): The Owner’s Independent Coatings Consultant (ICC) is a consultant hired and contracted by the Owner and may be included in the project for exterior coatings assessments and testing. Contractor is not typically required to coordinate with the ICC. As information to Contractor, the Owner’s ICCs are as follows:
 1. KTA-Tator, Inc., Dobson, NC. Contact: Kevin Brown, (336) 386-4000, kbrown@kta.com.
 2. Building Engineering-Consultants, Inc. (BE-CI), Destin FL. Contact: Josh Tatum (850) 650-2311 or (850) 461-4004, jtatum@be-ci.com.
 3. The ICC’s scope is separate from and does not relieve Contractor’s responsibility for conformance with the Contract Documents.
- F. Coating Manufacturer's Technical Representative: Maintain communications with a Manufacturer’s Representative who is qualified to provide site observations and recommendations. Upon completion of the painting, ensure that the Manufacturer’s Technical Representative provides recommendations for correction of any noted deficiency.
 1. Contractor’s requirements for coordinating Manufacturer’s Representative visits are specified in Part 3 herein.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Verify manufacturers’ national accounts purchase order procedure in order to ensure timeliness of delivery and accuracy of products.
- C. Paint orders shall identify the store number, location, batch number and address of project.
- D. Delivery of paint materials shall be in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and/or reducing. Notify Supplier when delivered products are nonconforming.
- E. Store coating materials in a location conforming to the manufacturers specified ambient conditions for storage and away from direct sunlight. Unless otherwise required by the manufacturer, maintain storage at temperature between 45 and 95 F.

1.8 EXTERIOR COATINGS WARRANTY

- A. Manufacturer’s Extended Material Performance Warranty: The products and systems specified in the Coatings Systems Schedule in Part 3 herein have been selected by Owner as having met or exceeded Owner’s Extended Material Performance Warranty criteria.
- B. Performance requirements for the Manufacturers’ selected coatings are as follows:

STANDARD CONDITIONS	The standard system is used for new construction in normal climates and when substrate is not identified as having special conditions.
8-Year Minimum Coatings Performance for All Exterior Metal Ferrous, Non-Ferrous, SSMR Panels	
<ul style="list-style-type: none"> • Remains free from of peeling, blistering, flaking, cracking, rusting, or rust bleed-through. • Mold and mildew resistant in accordance with the criteria of ASTM D3273. • Maintains adhesion to the underlying substrate with a minimum adhesion rating of 8 in accordance with ASTM D 6677. • Demonstrates fading not beyond a 5 delta E value for neutral and bold brand color from the color at the time of initial installation as determined by ASTM D 2244 criteria. • Demonstrates chalking not less than a 9 from the time of initial installation as determined by ASTM D 4214 criteria. • Meets US VOC regulations 	
8-Year Minimum Coatings Performance for Concrete Substrates	
<ul style="list-style-type: none"> • Coating remains free from of peeling, blistering, flaking, and cracking. • Mold and Mildew resistant in accordance with the criteria of ASTM D 3273. 	

<ul style="list-style-type: none"> • Maintains adhesion to the underlying substrate with a minimum adhesion rating of 6 in accordance with ASTM D 6677. • Demonstrates fading not beyond a 7 delta E value for neutral colors and not beyond a 7 delta E value for the bold brand color from the color at the time of initial installation as determined by ASTM D 2244 criteria. • Demonstrates chalking not less than a 7 from the time of initial installation as determined by ASTM D 4214 criteria. • Passes the Wind-Driven Rain test for exterior coatings in accordance with ASTM D 6904. • Demonstrates a flat or low-sheen finish. 	
8-Year Minimum Coatings Performance for Water Repellents	Blended water repellent (Silane/Siloxane) for porous material.
<ul style="list-style-type: none"> • Appearance of substrate remains unchanged after application. • Demonstrates resistant to yellowing and efflorescence. • Demonstrates suitability to be re-coated with conventional paints. • Maintains at least 99% improvement in water repellency in accordance with ASTM E 514. • Maintains water vapor permeance of a minimum 40 perms as determined according to test method B (wet cup) of ASTM D 1653. 	

SPECIAL CONDITIONS	In addition to the minimum criteria, coatings shall perform to the following when installed on stores identified as demonstrating special conditions.
Elongation	For Building conditions with excessive cracking where crack bridging is necessary. <ul style="list-style-type: none"> • Material shall be capable of 300% elongation for crack bridging in accordance with ASTM D 2370.

REGIONAL CONDITIONS	In addition to the minimum criteria, coatings shall perform to the following when installed on stores subject to one of the following climate conditions.
Cold Temperature Installation	In situations when the Building coatings must be installed during cold weather. <ul style="list-style-type: none"> • Coatings shall be suitable for application down to 40 degrees F.

- C. Obtain a Statement of Intent to Warrant from the manufacturer for each exterior coating system used in the project. Submit the Intents to Warrant as closeout documents as specified in Part 1 herein.

1.9 EXTERIOR WORKMANSHIP WARRANTY

- A. Labor and Workmanship Warranty: Contractor shall provide an additional two years Labor and Workmanship Warranty beyond the Contractor’s one-year warranty period required in the Owner’s General Conditions. Contractor’s Labor and Workmanship Warranty shall warrant against loss of adhesion, cracking, peeling, blistering, shadow-through, splotch or non-continuous appearance, color fade, application of incorrect color, and any other surface preparation or application deficiency described herein or identified by either the coatings manufacturer or the Owner’s authorized inspection representative during its site observations.
- B. Uncorrected deficiencies identified by Owner’s Representative during the work or within two years after completion of the work may require complete recoating at Contractor’s expense with no cost to the Owner.
- C. Submit the two-year Exterior Labor and Workmanship Warranty as a closeout document as specified in in Part 1 above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Coatings shall be the products of the following manufacturers:
1. Interior Coatings:
 - a. [Sherwin Williams Company](#). Contact: Kevin Behm, (216) 566-1558, kevin.c.behm@sherwin.com.
 - b. [Benjamin Moore](#), Contact: Andrew Theokas, (201) 747-1586, andrew.theokas@benjaminmoore.com.
 - c. [PPG Paints](#), Contact: Rick Garlin, (317) 318-5800, garlin@ppg.com.

2. Exterior Coatings:
 - a. [PPG Paints](#), Contact: Rick Garlin, (317) 318-5800, garlin@ppg.com.

- B. Method of Coatings Purchase: Manufacturers may require products to be purchased and distributed from national distribution centers as a warranty condition. Verify conditions of purchase with the manufacturer selected for project. Comply with manufacturer's national accounts purchase order procedure in order to ensure integrity of product and observance of warranty.
- C. Manufacturer's Approved Color Formulations: Provide only those coatings produced in accordance with the manufacturer's approved color formulations, including the following:
 1. Exterior Bold Brand Color: Bold brand Walmart blue with a urethane-like appearance shall be mixed and tinted only in the manufacturer's authorized factory facility. Do not order or permit bold brand color to be mixed and tinted either in the field or at a retail store.
 2. Exterior Neutral Colors: Some manufacturers permit neutral gray or tan color scheme coatings to be mixed and tinted in the retail store. Verify with manufacturer's authorized representative that neutral scheme coatings mixed and tinted in the retail store will receive the Manufacturer's Material Performance Warranty as described in Part 1 herein.
- D. Products Schedule: Owner's preselected coating products are listed in the Product Schedules in Part 3 herein.

2.2 ACCESSORY MATERIALS

- A. Accessory materials not specified herein but recommended by the manufacturer or required to meet the requirements herein.
 1. Paint Thinners: Type recommended by paint or coating manufacturer for paint or coating system, VOC compliant, first line commercial quality.
 2. Patching Materials: As specified under Part 3 - Execution.
 3. Masking.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and adjacent areas where products will be applied and verify that surfaces conform to product manufacturer's requirements for substrate conditions. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of application indicates acceptance of substrate conditions.

3.2 GENERAL PREPARATION

- A. Contain fugitive dust and debris from contaminating surrounding property. Protect personnel from airborne dust and abrasive media. Establish dust containment and safety zones with caution tape or barricades prior to beginning to isolate work in areas of facility operations.
- B. Do not schedule surface preparation and other dust generating work near areas which have wet, newly coated surfaces.
- C. Verify that all coats in the proposed system are produced by the same manufacturer.
- D. Protect other surfaces from paint and damage with protective coverings, shields, masking, etc. Maintain protective coverings throughout cleaning and painting operations.
 1. Adjacent work to be protected includes but is not limited to, merchandise inventory, vehicles, and vegetation.
 2. Remove or mask hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be painted. Reinstall removed items after completion of paint work.
- E. Protect the following items from water damage during pressure washing and overspray during application:
 1. Automatic door sensors.
 2. Exterior light sensors.

3. Store mounted electronic devices, switches, receptacles and security components.
 4. Fire Protection sprinklers.
- F. For any work specified herein requiring chemical strippers, use plastic, tape, or other means to protect areas that are not to be stripped. This includes prefinished metal such as gutters and downspouts, aluminum trim and storefront and glass.
- G. Sealants:
1. Exterior Fiber Cement Panels: Remove failing or moving sealants and any loose materials from joints. Replace removed sealants with new materials as specified in Section 07900.
- H. Do not schedule paint work when rain, snow, fog, or mist are present or forecasted to be present during the drying time of the coatings.
- I. If plants, moss, mildew, or other biological growth is present, thoroughly saturate the area with a mixture consisting of 1 quart bleach/3 quarts water, and 1 cup powdered detergent. Allow the mixture to remain on the surface until the biological growth is removed. Scrub the surface and repeat as necessary to assure complete removal. Thoroughly rinse with fresh water.
- J. If the manufacturer's written recommendations conflict with or do not address the unique project conditions, comply with the requirements of this specification unless otherwise directed.
- K. Verify product are within shelf life. Schedule application of multi-component materials prior to expiration of the pot life.
- L. Perform preparation and cleaning procedures as specified in this section and in accordance with paint manufacturer's and Owner's authorized representative's direction as necessary for unique project conditions. Work directed and performed in addition to that specified herein but deemed necessary by the Manufacturer's or Owner's Representatives to achieve a satisfactory substrate shall be by change order to the Contract.

3.3 SURFACE PREPARATION

- A. Do not begin surface preparation of exterior walls until the sample wall panel specified in Part 1 has been completed and approved.
- B. Where scraping, chiseling, sanding, or grinding of concrete surfaces is required, use proper dust control tools and methods to maintain dust emissions below the permissible level.
- C. Remove visible grease and oil by solvent cleaning in accordance with SSPC-SP1.
- D. Protect joints to be sealed by inserting caulking backer rods at face of wall.
- E. Pressure Washing:
1. Remove loose paint, chalk, efflorescence, oil, grease and surface contamination by pressure washing when specified in the following surface preparations.
 2. Use equipment with at a minimum 5,000 psi and a spinner tip.
 3. If removing heavy chalk, use a TSP and water solution. Add .5 lbs. of TSP per 1 gallon of water. Apply to the wall surface using a low pressure sprayer and allow 20-30 minutes before rinsing.
 4. Thoroughly rinse the surface to ensure that no residue of TSP solution remains and to remove loose paint. To rinse, power wash the surface using a 5,000 psi pressure washer with a spinner tip. Scrub the surface with a soft bristled brush to remove any remaining chalk residue if necessary.
 5. Wipe a white cloth across the surface to ensure that no residue is visible on the cloth.
 6. As an alternative to TSP, a chalk removal additive recommended by the coating manufacturer can be used.
 7. If the surface cleanliness is not achieved using 5,000 psi pressure washing equipment, use heated pressure washing equipment (200F or higher) or contractor-selected equipment to achieve the specified degree of cleaning.
 8. Dispose of the wastewater as specified in the Environmental Requirements of Part 1 and in accordance with 01351.

- F. Steel - Exterior:
1. Remove dust, dirt buildup, grease, oil, mold, mildew, chalk, dirt, and surface debris. Pressure wash as specified in Part 3 herein to clean the surface.
 2. Remove minor rust, loose paint, and surface contamination with power tools in accordance with SSPC-SP3.
 3. Sand glossy surfaces with 220 grit sandpaper.
- G. Steel - Interior:
1. Remove dirt, dust, grease, oil, and other surface interference material by washing and scrubbing.
 2. Remove rust and loose paint with power tools in accordance with SSPC-SP3.
 3. Degloss surface with a scouring pad such as [Heavy Duty Scour Pad](#), [Non-Scratch Scour Pad](#), or equivalent by Scotch-Brite.
- H. Galvanized Steel - Exterior:
1. Remove dust, dirt buildup, grease, oil, mold, mildew, chalk, dirt, and surface debris. Pressure wash as specified in Part 3 herein to clean the surface.
 2. Remove loose coating, corrosion, deteriorated steel, and zinc salts by power tool in accordance with SSPC-SP3.
 3. Sand glossy surfaces with 220 grit sandpaper.
 4. On bare galvanizing, apply a solution of phosphoric acid and detergents designed to remove grease and oil residue to provide a clean, lightly etched surface suitable for adhesion of subsequently applied coats in accordance with the manufacturer's instructions.
- I. Galvanized Steel - Interior:
1. Remove dirt, dust, grease, oil, and other surface interference material by washing and scrubbing.
 2. Remove deteriorated galvanized steel, rust, and loose paint with power tools in accordance with SSPC-SP3.
 3. Degloss surface with a scouring pad such as [Heavy Duty Scour Pad](#), [Non-Scratch Scour Pad](#), or equivalent by Scotch-Brite.
 4. On bare galvanizing, apply a solution of phosphoric acid and detergents designed to remove grease and oil residue to provide a clean, lightly etched surface suitable for adhesion of subsequently applied coats in accordance with the manufacturer's instructions.
- J. Concrete Floors – Interior (to Receive Striping and Markings):
1. Mask floor surfaces that will not receive coating.
 2. Remove visible grease and oil deposits by detergent or solvent cleaning.
 3. Remove curing compound and sealers with solvents, commercial paint strippers, power tool cleaning, or abrasive blast cleaning using dust control methods specified herein for Full Coating Removal.
 4. Chemically or mechanically abrade surface to a texture of 50-70 grit sandpaper.
 5. If applying acid etching compound, thoroughly flush surface with clean water. Verify removal of acid with pH paper and allow the floor to thoroughly dry prior to painting.
 6. Protect painted floor surface from traffic for 12 hours after painting.
- K. Exterior Fiber Reinforced Cement Panels (FRCP):
1. Pressure wash surfaces of panels to remove grease and oil residue, efflorescence, and other contaminants to provide a clean, lightly etched surface suitable for adhesion of subsequently applied coats.
 - a. Where pressure washing is not feasible, clean surfaces by methods including compressed air, hand washing with biodegradable detergent and sponge or rags, broom cleaning, or solvent based cleaners.
 2. If mildew is present, use mildew removal method as recommended by the FRCP manufacturer.
 3. Rinse any remaining chemical films left by solvent cleaners.
- L. Wood:
1. Remove surface contamination by washing with a cleaning solution, scraping, sanding, and scrubbing to remove dirt, pollutants, mildew, deteriorated wood, and surface interference material.
 2. Allow to dry and apply patching material recommended by the coating manufacturer to fill cracks, nail holes, and other imperfections. Sand the patched areas smooth after drying.
 3. Scrape and clean small, dry, seasoned knots and apply a thin coat of knot sealer recommended by the coating manufacturer before applying prime coat.
 4. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dry.

5. Prime, stain, or seal wood required to be field painted immediately upon delivery to site. Prime edges, ends faces, undersides, and backsides of such wood, including cabinets and counters.
6. Seal tops, bottoms, and cut-outs with a heavy coat of sealer recommended by the coating manufacturer immediately upon delivery to the site.
7. Allow the surface to dry before applying new coatings. Prior to painting, verify dryness by testing in accordance with the manufacturer's instructions and the meter and plastic sheet methods as specified in Part 3 herein

M. Gypsum Board:

1. Fill minor defects with filler compound. Spot prime defects after repair.
2. Exterior Gypsum Board Sheathing: Exterior gypsum board sheathing to receive a paint finish shall be prepared for painting with joint treatment and skim coating as specified in Section 09250.

3.4 APPLICATION - GENERAL

- A. Apply paint to surfaces free of dirt, rust, scale, grease, moisture, scuffed surfaces, and conditions otherwise detrimental to formation of a durable paint film.
- B. Do not substitute or interchange products or coatings systems presented at the Pre-Installation Conference unless otherwise authorized by Owner's authorized representative.
- C. Do not paint silicone sealants designated by an S1 or S2 assignment as described in Section 07900.
- D. After cleaning and prior to painting, determine surface and subsurface moisture of non-metal substrates in compliance with the manufacturer's instructions and the following methods:
 - a. Radio frequency and conductivity moisture meter testing with results in the green range for conductivity and the yellow range or below for radio frequency.
 - b. Plastic sheet testing in accordance with ASTM D 4263 to determine the presence of capillary moisture. Levels are acceptable when dry on the plastic and the block.
- E. Mixing and Thinning:
 1. Mix coatings in clean containers in accordance with the manufacturer's published instructions.
 2. Remove skins on acrylic coatings prior to mixing. If mixed into the coating, remove skin residue by straining prior to use.
 3. Stir paint materials as necessary during use to maintain the consistency.
- F. Touch up shop-applied prime coats where damaged or bare. Use the same primer applied in the shop.
- G. If application procedures are not specified herein, use application procedures designated by the manufacturer's published instructions for the particular application and substrate.
- H. Dry Film Thickness (DFT) shown in the Product Schedules in Part 3 herein represent the minimum Dry Film Thickness in mils per coat. Apply each coat to uniform coverage. Avoid excessive thickness that results in runs, sags, and solvent voids in the film.
- I. Measure or allow to be measured the Wet Film Thickness (WFT) of exterior coatings if manufacturer's representative or Owner's authorized representative requires.
- J. Allow drying time between coats as recommended by the manufacturer.
- K. When coating irregular surfaces including edges, corners, crevices, welds, and exposed fasteners, apply a minimum dry film thickness equivalent to that of flat surfaces.
- L. Prime Coats, General: Before application of finish coats, apply a prime coat of material as scheduled. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

- M. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Apply additional coats if shadow through of underlying coats or substrate is visible. Cloudiness, spotting, laps, brush marks, runs, sags or other surface imperfections will not be acceptable.

3.5 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Replace identification markings on mechanical or electrical equipment when painted over or spattered.
- B. Where exposed piping, conduit, and electrical equipment are to be painted, paint color and texture shall match adjacent surfaces.
- C. Paint both sides and edges of plywood backboards for electrical equipment prior to installation.
- D. Pre-paint gas piping prior to installation. Touch up paint after installation to repair damage. Colors shall be as follows:
 - 1. Exterior Piping on Roof (Yellow): P5, OSHA Standard "Safety Yellow."
 - 2. Interior Piping in Receiving and Stockroom Areas (Yellow): P5, OSHA Standard "Safety Yellow."
 - 3. Piping in all Other Areas: Color to match adjacent surfaces.

3.6 INTERIOR FIELD QUALITY CONTROL

- A. Interior Coatings and Exterior Coatings on Surfaces Other than Exterior Wall: Inspect painting and coating application for scheduled material, color, sheen, specified thickness (WFT where indicated and DFT), and coverage.

3.7 EXTERIOR FIELD QUALITY CONTROL

- A. Exterior Wall Work in Progress Inspections:
 - 1. Contractor's Installation Inspections:
 - a. Maintain schedule of application of exterior wall systems in field office for Owner's review.
 - b. Enter any painting defects defined as deviations, as well as recommended repairs by Owner's Construction Manager or Manufacturer's Technical Representative during progress inspections into the online Owner's Observation Log.
 - c. Maintain photographic documentation of application for Contractor's Completion Report as specified in Part 1 herein as a closeout document.
 - d. Conduct the following inspections and tests each day, as applicable. Document and make available to the Owner's Construction Manager.
 - 1) Ambient conditions during the work, including air temp, surface temp, relative humidity, dew point.
 - 2) Quality of surface preparation on each item prepared, including cleanliness and roughness, removal of chalk and loose paint, removal of biological growth, de-glossing, pressure washing, power tool cleaning, etc.
 - 3) Moisture content of cementitious surfaces prior to painting.
 - 4) Application, including product names, quantities, and locations of coatings applied.
 - 5) Methods of application, including whether spray, brush, roll, back-rolling, etc.
 - 6) Wet film thickness of coatings applied as measured at a minimum of 5 spots per 100 square feet or fraction thereof. Dry film thickness of coatings applied to metal as measured at a minimum of 5 spots per 100 square feet or fraction thereof.
 - 7) Quality of application, including aesthetics, coverage, presence of pinholes and shadow-through.
- B. Exterior Wall Post-Installation Inspections:
 - 1. Post-Installation Site Visits: Upon completion of the coating system installation, schedule site visits with the Manufacturer's Technical Representative.
 - a. Provide a minimum one week notification for the scheduling of final inspections.
 - b. Include Owner's authorized representative if available.
 - c. Verify that Manufacturer's Representative's observations include inspection of all specification requirements and comparison with the sample panel specified herein.
 - 2. Manufacturer Post-Installation Site Visit: Schedule a site visit with Manufacturer's Technical Representative.
 - a. Manufacturer's Representative shall be the same individual present at pre-construction conference.

- b. Record noted deficiencies and recommendations observed by the Manufacturer's Technical Representative.
 - c. Remediation of Deficiencies: If the Representative notes deficiencies, provide remediation as recommended by the Representative and necessary to achieve compliance with the specification requirements.
 - 1) Record products, methods of application, location, and quantities of coatings for remediation work.
- C. Fine for Failure to Remediate: If the Manufacturer's Representative or Owner's authorized representative determine that remediation work is not complete in accordance with the recommendations of the post-installation report and in conformance with the requirements herein, Owner may assess a fee of \$3,000.00 at Contractor's expense with no cost to the Owner.

3.8 MAINTENANCE OF WORK AREA

- A. As work proceeds and upon completion, remove paint where spilled, splashed, or spattered.
- B. During progress of work keep premises free from unnecessary accumulation of tools, equipment, surplus materials and debris. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint material from the site.
- C. Collect waste, cloths, and material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- D. Upon completion of work, leave premises neat and clean. Remove protective coverings and paint from doorknobs, floors, counter tops and other areas not requiring paint.

3.9 PROTECTION

- A. Repair damage as a result of inadequate or unsuitable protection during preparation or installation.
- B. Do not leave plastic or other landscape protection covers in place so long that damage to plants results.

3.10 PAINT COLOR SCHEDULES

- A. Exterior Colors: Provide colors as shown or scheduled on the drawings.
- B. Interior Building Colors: Provide colors as shown or scheduled on the drawings.

3.11 PAINT SHEEN SCHEDULE

- A. Gloss:
 - 1. Exterior metal surfaces, including prefinished metal where shown to be painted.
 - a. Prefinished roof edge fascia.
 - 2. Exterior hollow metal doors and frames (inside and outside surfaces).
 - 3. Roof hatch (inside and outside surfaces).
 - 4. Interior & exterior pipe bollards shown to be painted.
 - 5. Interior & exterior metal railings.
 - 6. Metal stair stringers and handrails.
 - 7. Metal fixed ladders and cages.
 - 8. Exterior composite overhead sectional door surface if shown to be painted.
- B. Semi-gloss:
 - 1. Interior hollow metal doors and frames.
 - 2. Interior hollow metal window frames.
 - 3. Wood trim or simulated wood trim scheduled to be painted.
 - 4. Coiling metal counter doors, except aluminum coiling counter shutters at Pharmacy.
 - 5. Toilet gypsum board ceilings.
 - 6. Interior columns surfaces to receive epoxy finish.

7. Exterior fiber reinforced cement panels if shown to be painted.

C. Eggshell:

1. All surfaces to be painted where sheen is not otherwise specified.

D. Flat:

1. Exterior gypsum board ceilings.
2. Exterior concrete.

3.12 ITEMS TO BE PAINTED SCHEDULE

A. Paint surfaces as shown or scheduled on the drawings including, but not limited to, the following items.

1. Exterior: Paint exterior surfaces as shown and noted on the Drawings, including, but not limited to:
 - a. Hollow metal doors and frames.
 - b. Metal opening frames and trim.
 - c. Metal or fabric canopy columns and supporting steel structure components where shown on Drawings.
 - d. Metal flashing and downspout (surfaces exposed from ground level).
 - e. Metal gutters (surfaces exposed to view from ground level).
 - f. All surfaces of metal parapet cap.
 - g. Parapet walls, roof side (where roofing does not occur).
 - h. Pipe bollards where shown to be painted.
 - i. Metal railings.
 - j. Roof hatch.
 - k. Satellite dish support (from bottom of deck to top of support).
 - l. Exposed rooftop refrigeration and HVAC support framing.
 - m. Overhead doors if shown.
 - n. Paving graphics and markings.
 - o. Exposed piping and conduit, hangers and supports.
 - p. Exterior fiber reinforced cement panels if shown to be painted.
2. Interior: Paint interior surfaces as indicated on the Drawings including, but not limited to:
 - a. Hollow metal doors and frames.
 - b. Hollow metal window frames.
 - c. Overhead coiling doors.
 - d. Metal opening frames and trim.
 - e. Gypsum wallboard.
 - f. Pipe Bollards shown to be painted.
 - g. Metal railings.
 - h. Exposed plywood.
 - i. Plywood wainscot, if shown to be painted.
 - j. Exposed overhead structure including joists, girders, bridging, miscellaneous metal fabrications and deck (if scheduled to be painted).
 - k. Exposed structure columns.
 - l. Floor striping, graphics, and markings as shown or noted.
 - m. Metal stair stringers and handrails.
 - n. Exposed wood trim.

B. Do not paint the following Items:

1. Aluminum, brass, bronze, stainless steel, and chrome plated steel.
2. Pre-finished items, such as toilet compartments, acoustical ceiling materials, mechanical, and electrical equipment or factory finished metal panels and trim, unless otherwise shown or specified.
3. UL, FM, and other code-required labels.
4. Equipment identification, performance rating, and name plates.
5. Finish hardware.
6. Fire Suppression sprinklers.
7. Low voltage cabling (i.e. fire alarm, voice, data, EMS, audio, security) not in conduit.

3.13 PRODUCT SCHEDULES - EXTERIOR

- A. Refer to the following schedules to verify exterior coating characteristics, manufacturer’s recommended DFT, and installation temperature for the coatings in the selected system.

EXTERIOR PRODUCTS – PPG

PPG Products					
Product Name	DFT (mils)	VOC (g/l)	Perm	Min Temp(°F)	Elongation
PPG 4-100XI Filler	8.0-11.0	<100	46.13	35	--
PPG Perma-Crete High Build 4-22XI	3.2-5.8	<100	--	35	--
PPG Perma-Crete 4-9110 Solvent Acrylic	8.5	397	--	20	--
PPG Durethane-DTM-95-3300	3.0-5.0	241	--	40	--
PPG Perma-Crete 4-809/4-808 Sealer	0.7-1.3	228	52.11	35	--
PPG Timeless 73-410	2.2-2.6	<50	28.31	35	--
PPG PSX One	3.0	210	--	40	--
PPG Perma-Crete 4-110XI	5.4-7.2	<50	33	35	340%
PPG Amercoat One	4.0-6.0	309	--	50	--
PPG Amerlock 2	4.0-8.0	180	--	32	--
PPG BRP Urethane 1501	1.5-2.0	130	--	60	--
PPG Pitt-Tech 4020PF	2.2-3.5	91	--	50	--
PPG Flood Pro FLD812 Stain	0.7-0.9	<250	--	35	--
PPG Flood Pro FLD820 Stain	1.0-1.5	<100	--	35	--
PPG 17-921 Seal Grip Primer	1.5	84	--	35	--

3.14 COATINGS SYSTEM SCHEDULES - EXTERIOR

- A. Additional Considerations for Exterior Prime Coats: Prime coat type or thickness may depend on the condition of the substrate after field preparation does not yield typical results. Where additional determination regarding prime coat is based on atypical substrate conditions, an asterisk and footnote mark the field of the selected system in the System Schedule.
 - 1. If prepared substrate demonstrates chalking, provide the conditioner prime coat in the system.

PPG				
PRECAST CONCRETE PANELS				
Application	Sheen	PPG		
		Prime Coat		Finish Coat
Precast Non-Coastal Regions	Flat	PPG Perma-Crete 4-809/4-808 Sealer		PPG Timeless 73-410
Precast Elastomeric/Coastal Regions	Flat	PPG Perma-Crete 4-809/4-808 Sealer		PPG Perma-Crete 4-110XI
GALVANIZED WALL CAPS				
Application	Sheen	PPG		
		Prime Coat		Finish Coat
Galvanized wall caps	Gloss	PPG Amercoat One		PPG PSX One
PPG				
FIBER SIDING, TIMBER, GYP, AND PAVEMENT				
Substrate Description	Sheen	PPG		
		Prime Coat	Finish Coat 1	Finish Coat 2
Fiber cement siding in any condition	Flat	PPG Perma-Crete 4-809/4-808 Sealer	--	PPG Timeless 73-410
Gypsum Board ceiling	Flat	PPG 17-921 Seal Grip Primer	--	PPG Timeless 73-410
Concrete pavement	Eggshell	--	--	--

PPG				
EXTERIOR FERROUS METAL – GENERAL CONDITIONS				
Substrate Description	Sheen	Conditions of Use	PPG	
			Prime Coat	Finish Coat(s)
Ferrous Metal – Misc steel doors, frames, and structural steel, except steel associated with roofs or canopies	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG PSX ONE
	Gloss	Cold Temp	PPG Amerlock 2	PPG PSX ONE
Ferrous Metal – Rooftop equipment framing	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG BRP Urethane 1501
	Gloss	Cold Temp	PPG Amerlock 2	95-3300 Durethane
EXTERIOR FERROUS METAL AND GALVANIZING – SPECIAL CONDITIONS				
Special Conditions Ferrous Metal and Galvanizing: Heavy corrosion; steel/ galvanized to ground interface; wall cap waterproofing	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG BRP Urethane 1501 2 coats
	Gloss	Cold Temp	PPG Amerlock 2	95-3300 Durethane 2 coats
Ferrous Metal and Galvanized	Semi-Gloss	Standard Climate or High UV	PPG Amercoat One	PPG BRP Urethane 1501 2 coats
	Semi-Gloss	Cold Temp	PPG Amerlock 2	95-3300 Durethane 2 coats
EXTERIOR NON-FERROUS METAL AND GALVANIZING				
Non-Ferrous Metal and Galvanized ornamental metal fencing	Semi-Gloss	Standard Climate or High UV	PPG Amercoat One	PPG PSX1
		Cold Temp	PPG Amerlock 2	PPG PSX ONE
Non-Ferrous Metal and galvanized trim	Semi-Gloss	Standard Climate or High UV	PPG Amercoat One	PPG PSX ONE
		Cold Temp	PPG Amerlock 2	PPG PSX ONE
EXTERIOR PREFINISHED METAL				
Prefinished Metal - Prefinished metal panels and trim	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG PSX ONE
		Cold Temp	PPG Amerlock 2	PPG PSX ONE
Prefinished metal factory finish (e.g., signage at new receiving dock doors)	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG PSX ONE
		Cold Temp	PPG Amerlock 2	PPG PSX ONE
Prefinished metal framing for standing seam roof and canopies	Gloss	Standard Climate or High UV	PPG Amercoat One	PPG BRP Urethane 1501

END OF COATING SYSTEMS SCHEDULES - EXTERIOR

3.15 PRODUCT AND SYSTEM SCHEDULES - INTERIOR

- A. Select products and systems by one of the following manufacturers. Refer to the following Product Schedules to verify manufacturer’s recommended DFT.
- B. System Schedules for each manufacturer follow the Product Schedule.

Interior Products by Sherwin Williams		
Product Name	DFT (mils)	VOC (g/l)
Interior Metal		
ProCryl Universal Primer B66-310	2.0	100
Pro Mar 200 Interior Latex Gloss Enamel, B21W200	1.5	143
ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series	1.6	0
ProMar 200 Zero VOC Interior Latex Eggshell Enamel, B20-2600 Series	1.7	0
Waterborne Acrylic Dryfall, B42 Series	2.0	39
Epolon II Rust Inhibitive Epoxy Primer B67W400, B67A400, B67A400	4.0	300
Macropoxy 646- 100, B58W620, B58V620	5.0-10.0	100
WB Acrolon 100 Water Based Urethane B65-720, B65V720	2.0-4.0	<100
DTM Acrylic Coating B66-100 Series	2.5-4.0	<250
Interior Gypsum Board		
ProMar 200 Zero VOC Latex Primer, B28W02600	1.5	0
Pro Mar 200 Interior Latex Gloss Enamel, B21W200	1.5	143
ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31-2600 Series	1.6	0
ProMar 200 Zero VOC Interior Latex Eggshell, B202-2600 Series	1.7	0
Interior Wood		
ProMar 200 Zero VOC Latex Primer, B28W02600	1.5	0
PrepRite ProBlock Interior/Exterior Latex Primer Sealer B51 Series	1.4	97
ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31-2600 Series	1.6	0
Wood Classics Varnish Sanding Sealer, B26V43	1.2	522
Interior Concrete Floors		
Macropoxy 646-100, B58W620, B58V620	5.0-10.0	<100
Armorseal Tread-Plex, B90 Series	1.5-2.0	<100

Interior Systems by Sherwin Williams			
		Prime Coat	Finish Coat(s)
Interior Ferrous Metal			
INT 1	General Use – Gloss (unless specified otherwise)	ProCryl Universal Primer B66-310	2 coats: Pro Mar 200 Interior Latex Gloss Enamel, B21W200*
INT 2	General Use – Semi-Gloss (unless specified otherwise)	ProCryl Universal Primer B66-310	2 coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series
INT 3	General Use – Eggshell (unless specified otherwise)	ProCryl Universal Primer B66-310	2 coats: ProMar 200 Zero VOC Interior Latex Eggshell Enamel, B20-2600 Series Exception: Interior columns shall receive only one finish coat.
INT 4	Dryfall system over shop primed steel –overhead structure - Flat	To touch up prime welds, bare spots, blemishes, and scratches: ProCryl Universal Primer B66-310	1 coat: SW-eWaterborne Acrylic Dryfall, B42 Series
INT 5	Dryfall system over unprimed steel - overhead structure – Flat	ProCryl Universal Primer B66-310	1 coat: Waterborne Acrylic Dryfall, B42 Series

INT 6	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy – Semi-Gloss	Epolon II Rust Inhibitive Epoxy Primer B67W400, B67A400, B67A400	1 coat: WB Acrolon 100 Water Based Urethane B65-720, B65V720
INT 6 (CA)	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy - Semi-Gloss	Macropoxy 646- 100, B58W620, B58V620	1 coat: WB Acrolon 100 Water Based Urethane B65-720, B65V720
Interior Galvanized Metal			
INT 7	Latex for exposed ductwork, hangers, and supports – Semi-Gloss	ProCryl Universal Primer B66-310**	2 coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series
INT 8	Dryfall System for exposed ductwork, hangers and supports - Flat	ProCryl Universal Primer B66-310**	1 coat: Waterborne Acrylic Dryfall, B42 Series
Interior Gypsum Board			
INT 14	Latex System - Gloss	ProMar 200 Zero VOC Latex Primer, B28W02600	2 coats: Pro Mar 200 Interior Latex Gloss Enamel, B21W200*
INT 15	Latex System – Semi- Gloss	ProMar 200 Zero VOC Latex Primer, B28W02600	2 coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series
INT 16	Latex System - Eggshell	ProMar 200 Zero VOC Latex Primer, B28W02600	2 coats: ProMar 200 Zero VOC Interior Latex Eggshell Enamel, B20-2600 Series
Interior Wood			
INT 17	General Use – Latex – Semi-Gloss	ProMar 200 Zero VOC Latex Primer, B28W02600	2 coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series
INT 18	Exposed laminated wood roof structure – Latex – Semi-Gloss	PrepRite ProBlock Interior/Exterior Latex Primer Sealer B51 Series	2 coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel, B31- 2600 Series
INT 19	Transparent sealer	Wood Classics Varnish Sanding Sealer, B26V43	---
Interior Concrete Floors			
INT 20	Floor, and floor striping, graphics and markings - Semi-Gloss	Macropoxy 646- 100, B58W620, B58V620	2 coats: Macropoxy 646- 100, B58W620, B58V620

* Use for all states except CA. For CA projects, consult Manufacturer's Representative for compliant coating.

** Apply primer after light etching is accomplished in accordance with Galvanized Steel – Interior Surface Prep requirements in Part 3 above.

Interior Products by PPG Paints		
Product Name	DFT (mils)	VOC (g/l)
Interior Metal		
PPG Pitt-Tech Plus 4020 PF Acrylic DTM Primer	2.2	91
PPG Advantage 919-10 Gloss Acrylic Enamel	1.5	50
PPG Speed Hide 0 VOC Semi-Gloss Acrylic Enamel 6-4510XI Series	1.3	0
PPG Speed Hide 0 VOC Eggshell Acrylic Enamel 6-4310XI Series	1.5	0
PPG Super Tech Acrylic Flat Dryfall 6-725XI Series	2.2	30
PPG Rapid Coat DTR Epoxy Mastic 95-245 Series	4.0 -7.0	263
PPG Amerlock 400 VOC Semi-Gloss Epoxy	4.8-8.0	99
PPG Aquapon WB-E Ultra Low VOC Epoxy 98-E1 Series	2.0-3.0	26
PPG Pitt-Tech Gloss DTM Acrylic Enamel 90-0374 Series	2.0 – 3.0	192
Interior Gypsum Board		

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PPG Speed Hide 0 VOC Primer 6-4900XL	1.4	0
PPG Advantage 919-10 Gloss Acrylic Enamel	1.5	50
PPG Speed Hide 0 VOC Semi-Gloss Acrylic Enamel 6-4510XI Series	1.3	0
PPG Speed Hide 0 VOC Eggshell Acrylic Enamel 6-4310XI Series	1.5	0
Interior Wood		
PPG Speed Hide 0 VOC Primer 6-4900XL	1.4	0
PPG Seal Grip Acrylic Primer 17-921XI Series	1.6	50
PPG Speed Hide 0 VOC Semi-Gloss Acrylic Enamel 6-4510XI Series	1.6	0
PPG Deft Sanding Sealer DFT015 Clear	1.0	590
Interior Concrete Floors		
PPG Amerlock 400 VOC Semi-Gloss Epoxy	4.8-8.0	99
PPG Breakthrough V70 Series Gloss Acrylic	1.5-2.0	211

Interior Systems by PPG Paints			
		Prime Coat	Finish Coat(s)
Interior Ferrous Metal			
INT 1	General Use – Gloss (unless specified otherwise)	Pitt-Tech Plus 4020PF Acrylic DTM Primer	2 coats: Advantage 919-10 Series Gloss Acrylic Enamel
INT 2	General Use – Semi-Gloss (unless specified otherwise)	Pitt-Tech Plus 4020PF Acrylic DTM Primer	2 coats: Speed Hide 0 VOC Semi-Gloss Enamel 6-4510XI Series
INT 3	General Use – Eggshell (unless specified otherwise) -	Pitt-Tech Plus 4020PF Acrylic DTM Primer	2 coats: Speed Hide 0 VOC Eggshell Enamel 6-4310XI Series Exception: Interior columns shall receive only one finish coat.
INT 4	Dryfall system over shop primed steel –overhead structure - Flat	To touch up prime welds, bare spots, blemishes, and scratches:	1 coat: Speed Hide Super Tech Flat Acrylic Dry fall 6-725XI
INT 5	Dryfall system over unprimed steel - overhead structure – Flat	Pitt-Tech Plus 4020PF Acrylic DTM Primer	1 coat: Speed Hide Super Tech Flat Acrylic Dry fall 6-725XI
INT 6	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy – Semi-Gloss	PPG Amerlock 400 VOC Semi-Gloss Epoxy	1 coat: PPG Aquapon WB-E Ultra Low VOC Epoxy 98-E1 Series
INT 6 (CA)	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy - Semi-Gloss	PPG Amerlock 400 VOC Semi-Gloss Epoxy	1 coat: PPG Aquapon WB-E Ultra Low VOC Epoxy 98-E1 Series
Interior Galvanized Metal			
INT 7	Latex for exposed ductwork, hangers, and supports – Semi-Gloss	Pitt-Tech Plus 4020PF Acrylic DTM Primer	2 coats: Speed Hide 0 VOC Semi-Gloss Enamel 6-4510XI Series
INT 8	Dryfall System for exposed ductwork, hangers and supports - Flat	Pitt-Tech Plus 4020PF Acrylic DTM Primer	1 coat: Speed Hide Super Tech Flat Acrylic Dryfall 6-725XI
Interior Gypsum Board			
INT 14	Latex System - Gloss	Speed Hide 0 VOC Primer Sealer 6-4900XI	2 coats: Advantage 919-10 Series Gloss Acrylic Enamel
INT 15	Latex System – Semi- Gloss	Speed Hide 0 VOC Primer Sealer	2 coats:

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		6-4900XI	Speed Hide 0 VOC Semi-Gloss Enamel 6-4510XI Series
INT 16	Latex System - Eggshell	Speed Hide 0 VOC Primer Sealer 6-4900XI	2 coats: Speed Hide 0 VOC Eggshell Enamel 6-4310XI Series
Interior Wood			
INT 17	General Use – Latex – Semi-Gloss	Speed Hide 0 VOC Primer Sealer 6-4900XI	2 coats: Speed Hide 0 VOC Semi-Gloss Enamel 6-4510XI Series
INT 18	Exposed laminated wood roof structure – Latex – Semi-Gloss	Seal Grip Acrylic Primer 17- 921XI Series	2 coats: Speed Hide 0 VOC Semi-Gloss Enamel 6-4510XI Series
INT 19	Transparent sealer	PPG –Deft Sanding Sealer DFT015	---
Interior Concrete Floors			
INT 20	Floor, and floor striping, graphics and markings - Semi-Gloss	PPG Amerlock 400 VOC Semi-Gloss Epoxy	2 coats: PPG Amerlock 400 VOC Semi-Gloss Epoxy

Interior Products by Benjamin Moore		
Product	DFT (mils)	VOC (g/l)
Interior Metal		
Ultra Spec® HP Acrylic Metal Primer HP04	2.0	48
Ultra Spec® HP D.T.M. Acrylic Gloss Enamel HP28	2.3	142
Super Hide® Zero VOC Interior Latex Semi-Gloss 358	1.2	0
Super Hide® Zero VOC Interior Latex Eggshell 357	1.3	0
Latex Dry Fall Flat 395	1.9	46
Corotech Polyamide Epoxy Primer V150	4.0	332
Corotech Epoxy Mastic Coating V160	4.6-7.2	184
Corotech Waterborne Amine Epoxy V440	1.5-1.9	206
Corotech Acrylic Epoxy V450 Semi-gloss	1.0-1.3	190
Ultra Spec® HP D.T.M. Acrylic Gloss Enamel HP28	2.3	142
Interior Gypsum Board		
Super Hide® Zero VOC Interior Latex Primer 354	1.3	0
Ultra Spec® HP D.T.M. Acrylic Gloss Enamel HP28	2.3	142
Super Hide® Zero VOC Interior Latex Semi-Gloss 358	1.2	0
Super Hide® Zero VOC Interior Latex Eggshell 357	1.3	0
Interior Wood		
Ultra Spec® 500 Interior Latex Primer N534	1.4	0
Insl-x® Prime All™ Multi-Surface Latex Primer Sealer AP-1000	1.3	29
Super Hide® Zero VOC Interior Latex Semi-Gloss 358	1.2	0
Lenmar® Rapid Seal Dual Purpose Sealer 1Y.519	1.1	548
Interior Concrete Floors		
Corotech Epoxy Mastic Coating V160	4.6-7.2	184
Tough Shield® Acrylic Floor and Patio Coating Satin Finish TS-3xxx	1.3-1.7	169

Interior Systems by Benjamin Moore		
	Prime Coat	Finish Coat(s)
Interior Ferrous Metal		
INT 1	General Use – Gloss (unless specified otherwise)	Ultra Spec® HP Acrylic Metal Primer HP04
		2 coats: Ultra Spec® HP D.T.M. Acrylic Gloss Enamel HP28

INT 2	General Use – Semi-Gloss (unless specified otherwise)	Ultra Spec® HP Acrylic Metal Primer HP04	2 coats: Super Hide® Zero VOC Interior Latex Semi-Gloss 358
INT 3	General Use – Eggshell (unless specified otherwise)	Ultra Spec® HP Acrylic Metal Primer HP04	2 coats: Super Hide® Zero VOC Interior Latex Eggshell 357
INT 4	Dryfall system over shop primed steel –overhead structure – Flat		1 coat: Latex Dry Fall Flat 395
INT 5	Dryfall system over unprimed steel - overhead structure – Flat	Ultra Spec® HP Acrylic Metal Primer HP04	1 coat: Latex Dry Fall Flat 395
INT 6	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy – Semi-Gloss	Corotech Polyamide Epoxy Primer V150	1 coat: Corotech Waterborne Amine Epoxy V440
INT 6 (CA)	Columns and Hollow Metal Door Frames as shown on Drawings to receive epoxy - Semi-Gloss	Corotech Polyamide Epoxy Primer V150	1 coat: Corotech Acrylic Epoxy V450 Semi-gloss
Interior Galvanized Metal			
INT 7	Latex for exposed ductwork, hangers, and supports – Semi-Gloss	Ultra Spec® HP Acrylic Metal Primer HP04	2 coats: Super Hide® Zero VOC Interior Latex Semi-Gloss 358
INT 8	Dryfall System for exposed ductwork, hangers and supports - Flat	Ultra Spec® HP Acrylic Metal Primer HP04	1 coat: Latex Dry Fall Flat 395
Interior Gypsum Board			
INT 14	Latex System - Gloss	Super Hide® Zero VOC Interior Latex Primer 354	2 coats: Ultra Spec® HP D.T.M. Acrylic Gloss Enamel HP28
INT 15	Latex System – Semi- Gloss	Super Hide® Zero VOC Interior Latex Primer 354	2 coats: Super Hide® Zero VOC Interior Latex Semi-Gloss 358
INT 16	Latex System - Eggshell	Super Hide® Zero VOC Interior Latex Primer 354	2 coats: Super Hide® Zero VOC Interior Latex Eggshell 357
Interior Wood			
INT 17	General Use – Latex – Semi-Gloss	Ultra Spec® 500 Interior Latex Primer N534	2 coats: Super Hide® Zero VOC Interior Latex Semi-Gloss 358
INT 18	Exposed laminated wood roof structure – Latex – Semi-Gloss	Insl-x® Prime All™ Multi-Surface Latex Primer Sealer AP-1000	2 coats: Super Hide® Zero VOC Interior Latex Semi-Gloss 358
INT 19	Transparent sealer	Lenmar® Rapid Seal Dual Purpose Sealer 1Y.519	---
Interior Concrete Floors			
INT 10	Floor, and floor striping, graphics and markings - Semi-Gloss		2 coats: Corotech Epoxy Mastic Coating V160

END OF COATING SYSTEMS SCHEDULES - INTERIOR

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END OF SECTION

09900-20

SECTION 10160 - METAL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Includes:

1. Stainless steel toilet compartments and screens, floor mounted, head rail braced.

B. Related Requirements:

1. Section 01600 – Product Requirements: Contractor’s Products Selection checklist.
2. Section 06100 - Rough Carpentry: Framing and plates within walls.
3. Section 10810 - Toilet Accessories: Coordinate compartment installation with subsequent accessory installation.

1.2 REFERENCES

- A. American National Standards Institute (ANSI): ANSI A117.1 - Specification for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.
- B. Americans with Disabilities Act (ADA), ADA-ADAAGS - 2010 ADA Standards for Accessible Design.
- C. State and local disabled accessibility requirements and guidelines.

1.3 SUBMITTALS

- A. Process for the following submittal is specific to the scope of this Section. Comply with the submittal requirements herein with respect to format and manner of submission, notwithstanding the Process and Responsibilities requirements specified in Part 1 of Section 01330.
- B. Submit a Restroom Partition Field Verification Template to the pre-selected Supplier as follows:
 1. Follow www.hjcinc.com/tpdems.pdf to locate the Verification Template PDF.
 2. Complete the Verification Template with the information required and return to Supplier as prompted by the smart message link on the face of the Verification Template form.
 3. Verify ADA clearances are maintained between toilet partitions and any room fixture.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer’s recommendations.
- B. Receive and accept products and report suspected defects and shipping discrepancies in compliance with the requirements of Section 01600.
- C. Product Compliance Inspection: Inspect delivered products for compliance with product descriptions in Part 2 herein. Report discrepancies to the Architect.
- D. Product Packaging: Products be shipped in manufacturer's standard packaging with identification markings on each component or package.

PART 2 - PRODUCTS

2.1 PRODUCT PROCUREMENT

- A. Purchase products specified herein from Haines, Jones & Cadbury as Owner's pre-selected supplier. Contact [Haines, Jones & Cadbury](#), (800) 459-7099, WMT@hjcinc.com.

2.2 MANUFACTURERS

- A. Subject to compliance with project requirements, HJC will supply pedestal floor mount stainless steel toilet compartments and screens as manufactured by the following:
 1. [Flush Metal Partitions](#), (631) 768-8301.
 2. [Global Partitions](#), (an ASI Company), (706) 827-2700.
 3. [Hadrian Solutions, ULC](#), (440) 942-9118.
- B. Provide products by the manufacturers listed herein. No substitutions allowed.

2.3 DESCRIPTION

- A. Stainless Steel Partitions (Pedestal Floor Mount): Provide systems with manufacturer's enhanced privacy options and other components as follows:
 1. Panels and Doors: Two-piece interlocking panel unit with corners brazed and finished smooth. Panel face minimum 22 gauge stainless steel 304, composite construction of insulated honeycomb core adhered to inner surfaces with moisture resistant adhesive, minimum 1-inch thick. Limited exposed fasteners on outside of partitions.
 - a. Panel and Door Height: 72-inch.
 - b. Pilaster Height: 82-inch top of headrail.
 - c. Mounting Distance from Floor: 9-inches for stalls and pilasters.
 - d. For ADA and ambulatory stalls, provide solid wood backing for grab bar installation as required.
 2. Floor Mount Pedestal Support: Adjustable, cast stainless steel.
 3. Headrail: Satin Extruded clear anodized type 6463T5 aluminum channel; anti-grip design.
 4. Wall and Side Panel Mounting Brackets: 71inch, 18 gauge stainless steel #4 finish. Full length continuous (71-inch) stainless steel "U" brackets at connections from panels to walls.
 5. No-Sight Privacy Strips: Satin Aluminum to match head rail and stainless steel.
 6. Finish: Textured "diamond" pattern similar to Rigidized 5WL.
- B. Hardware:
 1. Hinge: Cast stainless steel, wrap-around and through-bolted.
 2. Occupancy Indicator Slide Latch: Cast stainless steel surface mounted slide latch, thru-bolted. Strike keeper shall be wrap-around type, thru-bolted. Must allow lift of door for emergency access.
 - a. No. 50683 ADA Surface Mounted by Jacknob Corp, or equivalent latch provided or included with partition assembly by manufacturer.
 3. Coat Hook and Wall Bumper: Cast stainless steel with rubber bumper.
 4. Pull Handle: Cast stainless steel, through-bolted to door. 2 each in accordance with the requirements of ADA.
- C. Urinal Screens: Wall hung type, 24 inches by 48 inches to match toilet compartments.
- D. Screws/Fasteners: Tamper proof, stainless steel, 6-lobe/pin sex bolts and screws per manufacturer's installation instruction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Take site dimensions prior to fabrication of any items. Verify correct spacing of plumbing fixtures.

- B. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, level, and square. Secure units in position with manufacturer's anchoring devices and in accordance with manufacturer's instructions.
 - 1. Provide for adjustment due to minor floor variations.
 - 2. Install adjacent components for consistency of line and plane.
- B. Maintain 1/2 inch space between wall and panels, and between wall and pilasters.
- C. Attach panels and pilasters to bracket with through sleeve, tamperproof bolts, and nuts. Locate head rail joints at pilaster centerlines.
- D. Anchor urinal screen panels to walls with brackets in accordance with manufacturer's instructions to suit supporting wall construction.
- E. Attach panel brackets securely to walls using anchor devices.
- F. Conceal floor fastenings with pilaster shoes.
- G. Equip each door with hinges, one door latch and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors, not exceeding 1/4 inch.
- H. Install pull handles on both sides of toilet partition doors for handicapped and ambulatory stalls.
- I. Install pull handles on both sides of toilet partition doors for handicapped and ambulatory stalls.

3.3 ADJUSTING

- A. In Swinging Doors: Adjust hinges to hold doors in partially open position when unlatched.
- B. Accessible Stall In Swing Doors: Adjust hinges to gently return doors to closed position.
- C. Out Swinging Doors: Adjust hinges to gently return doors to closed position.

3.4 CLEANING

- A. Protection and Cleaning of Stainless Steel Toilet Compartments and Screens Prior to Possession
 - 1. Remove protective plastic coating from stainless steel partitions. Remove any residue from the plastic coating with mild soap and water.
 - 2. Caution: Muriatic acid or other caustic chemicals shall not be used to clean stainless steel products. Muriatic acid for cleaning masonry or similar hydrochloric acid type cleaners must immediately be neutralized and scrubbed off with clean water if splashed, sprayed, spilled or otherwise in contact with a stainless steel component.
 - 3. Immediately prior to possession, clean stainless steel toilet compartments and screens thoroughly using soap, ammonia, or mild detergent and water. Apply with sponge or soft cloth, rinse with clear water and wipe dry. Always rub in the direction of polish lines. Rinse thoroughly with fresh water after every cleaning operation. Clean and polish toilet partitions to a spotless luster. Wipe dry to avoid water marks.

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END OF SECTION

10160-4

SECTION 10220 - OPERABLE PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes manually operate4d paired panel partitions:

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound Transmission Requirements: Operable panel partition assembly tested in a full-scale opening, 14 by 9 feet, for laboratory sound transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
 - a. STC: Not less than 49.
 - 2. Noise Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound absorption performance according to ASTM C 423 and rated for not less than the NRC indicated.
 - a. NRC: Not less than 65.

1.3 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified. Include data on acoustical performance, surface-burning characteristics, and durability.
- B. Shop Drawings: Show location and extent of operable panel partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel. Show blocking to be provided by others. Include the following:
 - 1. Calculations: Calculate requirements for supporting operable panel partitions and verify capacity of carriers and track components to support loads; indicate deflection limits for partition and adjacent construction.
- C. Setting Drawings: For embedded items and cutouts required in other work, including support beam punching template.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, 6" x 6" of same thickness and material indicated for the Work.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:
 - 1. Panel face finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable panel partition manufacturer as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Fire-Test-Response Characteristics: Provide operable panel partitions with the following fire-test-response characteristics, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.
 - 2. Fire Growth Contribution: Textile wall coverings complying with the acceptance criteria of UBC Standard 8-2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel-Face Finish Material: Furnish full-width in quantity to cover both sides of two panels when installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for operable panel partitions is based on "Acoustiseal 932"; Modernfold operable panel partition. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:
 - 1. Hufcor Inc.
 - 2. Modernfold, Inc.

2.2 OPERABLE PANEL PARTITIONS

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- B. Dimensions: Fabricate operable panel partitions, from manufacturer's standard sizes, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
- C. Cap-Trimmed Edges: Protective aluminum perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.

- D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.
- E. Trim: Manufacturer's standard aluminum trim, finished as follows:
 - 1. Painted, as selected by Architect from manufacturer's full range.
- F. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.3 SEALS

- A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
 - 1. Seals made from materials and profiles that minimize sound leakage.
 - 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, extruded-PVC or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - 1. Automatically Operated: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than the 1-1/2-inch operating clearance between retracted seal and floor finish.

2.4 FINISH FACING

- A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Apply one-piece, seamless facings free from air bubbles, wrinkles, blisters, and other defects, with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 - 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
- B. Fabric Wall Covering: Manufacturers standard factory applied reinforced vinyl fabric weighing not less than 15 oz. per lineal yard.

2.5 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish selected by architect from manufacturer's full range.

3. Bracing: Braces as required for lateral support of operable partitions in accordance with manufacturer's written recommendations and shop drawings.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partition, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.
- E. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557, operable panel partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.

3.3 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 CLEANING AND PROTECTION

- A. Clean soiled surfaces, on completing installation of operable panel partitions, to remove dust, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.
- C. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION

SECTION 10260 - WALL AND CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Crash rails.
- B. Related Requirements:
 - 1. Section 09310 – Ceramic Tile: Stainless steel corner trim installed with ceramic wall tile.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Section 01600 - Product Requirements: Transport, handle, store, and protect Products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless specified otherwise, provide guards by one of the following manufacturers as specified:
 - 1. Construction Specialties, Inc., Hughesville, PA, (800) 233-8493.

2.2 CRASH RAILS

- A. Engineered PETG Crash Rail to be CS Acrovyn.
 - 1. RS-40N Crash Rail by Construction Specialties, Inc.
 - 2. 6" tall.
 - 3. Colors: Match P131 SW# 7102 White Flour, and P76 Custom Match #076 Walmart Medium Blue.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, square and plumb, secured rigidly in position.
- B. Attach crash rails with included standard adhesive. Install level and plumb.

3.4 SCHEDULE

- A. Crash Rails: Locate crash rails where shown on the drawings.

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END OF SECTION

10260-2

SECTION 10350 (10 7500) – FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum flagpoles.
 - 2. Flags.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. The Aluminum Association, Inc. (AA):
 - 1. AA DAF45 - Designation System for Aluminum Finishes.
- C. ASTM International (ASTM):
 - 1. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B 917 - Standard Practice for Heat Treatment Of Aluminum-Alloy Castings From All Processes.
- D. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. NAAMM 1001 - Guide Specifications for Design of Metal Flagpoles Manual.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Concord American Flagpole](#), a Division of HAPCO Pole Products; Abingdon VA (800) 527-3902, info@concordamericanflagpole.com.
 - 2. [Eder Flag Manufacturing Company](#), Oak Creek, WI. Contact Jill Fontaine, (800) 558-6044 x353.
- B. Substitutions: Comply with the requirements of Section 01600.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads determined according to NAAMM FP 1001.
 - 1. Flag Size: Design flagpole based upon 4 foot x 6 foot nylon flag.
 - 2. Basic Wind Speed: Design flagpole based on 93 mph wind speed.

2.3 FLAGPOLES

- A. Groundset Flagpoles: Provide cone tapered ground set flagpole fabricated from extruded aluminum tubing complying with ASTM B 221, Alloy 6063, with a minimum wall thickness of 5/32 inch. Heat treat after fabrication to comply with ASTM B 917, Temper T6.
 - 1. Length: 30 feet exposed. Overall length shall be as shown to include unexposed portion below ground.
 - 2. Mounting: Ground sleeve type.

2.4 FITTINGS AND ACCESSORIES

- A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated to match flagpole-butt diameter.
 - 1. Finish: Gold Anodized.
- B. External Halyard: Ball-bearing, non-fouling rotating or stationary truck assembly of cast metal with continuous 5/16-inch-diameter, braided nylon halyard, ground hoisted.
- C. Cleats: Cast aluminum 9 inch min. with fasteners.
 - 1. Finish exposed metal surfaces to match flagpole.
- D. Halyard Flag Snaps: Provide two swivel snap hooks per halyard.
- E. Cleat Box: Aluminum box with cylinder lock. Provide 2 keys.
- F. Mounting Hardware:
 - 1. Provide ground sleeve assembly including sleeve, centering wedges, collar, ground rod, and other required accessories.

2.5 FINISHES

- A. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; in accordance with AA DAF45, and seal aluminum surfaces with clear, hard-coat wax.

2.6 FLAGS

- A. Provide 4 ft. by 6 ft. nylon American flag with sewn stripes and embroidered stars.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where flagpoles will be installed. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install flagpoles where and as shown and according to manufacturer's written instructions.
- B. Install halyard and snaps leaving installation ready for use.
- C. Install cleat inside lockable cleat box mounted 5 feet above finished grade unless otherwise shown.

3.3 ADJUSTING AND CLEANING

- A. Clean flagpole surfaces immediately prior to installation.
- B. Adjust operating devices for smooth halyard and flag function.

END OF SECTION

SECTION 10511 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Box lockers with see-thru faces.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of metal locker.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.
 - 1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
 - 2. Recessed openings.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Box Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines
- B. Regulatory Requirements: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide not less than 1 shelf located no higher than 48 inches above the floor for forward, 54 inches above the floor for side reach.
 - 2. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

2.3 BOX LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Hollowell Clear View/Safety View Box Lockers as manufactured by List Industries Inc. or comparable product by one of the following:
 - 1. Republic Storage Systems
 - 2. Penco
 - 3. ASI Storage Solutions
- B. Doors: One piece; fabricated from scratch-resistant clear acrylic panels.
- C. Doors: One piece; fabricated from 0.060 (16ga) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges with injection molded polycarbonate panels.
- D. Body: Assembled by riveting bolting or welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (24ga) nominal thickness, with single bend at sides.
 - 2. Backs and Sides: 0.024-inch (24ga) nominal thickness, with full-height, double-flanged connections.
 - 3. Shelves: 0.024-inch (24ga) nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from 0.060-inch (16ga) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
 - 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- F. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Continuous Hinges: Manufacturer's standard, steel, full height.
- G. Latch: Hasp designed for use with either padlocks.
- H. Legs: formed by extending vertical frame members, or fabricated from 0.075-inch (14ga) nominal-thickness steel sheet; welded to bottom of locker.
 - 1. Provide prefinished metal closure panels attached to legs on all sides of lockers to enclose area below locker legs.
- I. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- J. Finish: Baked enamel or powder coat.
 - 1. Color: As selected by Architect from manufacturer's range of beige/tan colors available for quick ship options.

- K. Configuration: Provide 6-tier 12" wide x 12" deep lockers, factory ganged into 36" or 48" wide sections for installation.
- L. Configuration: Provide double tier 12" wide x 18" deep lockers, factory ganged into 36" or 48" wide sections for installation.

2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for preassembly at plant prior to shipping.
- D. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches above the floor.
- E. Continuous Sloping Tops: Provide sloping tops on all lockers, fabricated in lengths as long as practical, finished to match lockers, complete with end caps.

2.5 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.

2.6 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- C. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.
 - 1. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top of locker.
 - 3. Anchor back-to-back metal lockers to each other.
- B. Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where required to abut adjacent construction or to enclose inside corners of installations.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10520 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fire protection cabinets for portable fire extinguishers.
 - 2. Portable fire extinguishers.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.
- D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.03 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.05 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths and wall assembly ratings.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Acrylic Bubble: One piece.

2.02 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher .
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire End & Croker Corporation; .
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group; .
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc; .
 - d. Larsen's Manufacturing Company; .
 - e. Modern Metal Products, Division of Technico Inc.; .
 - f. Moon-American; .
 - g. Potter Roemer LLC; .
 - h. Watrous Division, American Specialties, Inc.; .
- B. Cabinet Construction: Match wall assembly rating.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Radiused-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
- E. Cabinet Trim Material: Same material and finish as cabinet.
- F. Door Material: Same material and finish as cabinet
- G. Door Style: Full bubble with frame.

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- H. Door Glazing: Molded clear acrylic bubble.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide manufacturer's standard.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

2.03 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Larsen's Manufacturing Company.
 - i. Moon-American.
 - j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - k. Potter Roemer LLC.
 - l. Pyro-Chem; Tyco Safety Products.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.04 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

- a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Larsen's Manufacturing Company.
 - h. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

2.05 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
- 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
- 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.06 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
- 1. Color and Gloss: As selected by Architect from manufacturer's full range .

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. Fire Extinguishers: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- E. Identification: Apply vinyl lettering at locations indicated.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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END OF SECTION

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SECTION 10810 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Toilet accessories and attachment hardware.
- B. Related Requirements:
 - 1. Section 01600 – Product Requirements: General procedures related to products. Contractor’s Product Selection Checklist.
 - 2. Section 06100 - Rough Carpentry: Blocking for attachment of accessories.

1.2 REFERENCES

- A. The publications below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store, and protect products in compliance with the requirements of Section 01600.
- B. Product Packaging: Products and equipment will be shipped in manufacturer's standard packaging with identification markings on each component or package.
- C. Receive and accept products and report suspected defects and shipping discrepancies in compliance with the requirements of Section 01600.
- D. Product Compliance Inspection: Inspect delivered products for compliance with product descriptions in Part 2 herein. Report discrepancies to the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from the following manufacturers as specified in the Schedule of Accessories hereinafter:
 - 1. American Specialties Co., Inc. (ASI), Yonkers, NY, (914) 476-9000.
 - 2. Bobrick Washroom Equipment, Inc., North Hollywood, CA, (818) 982-9600.
 - 3. Bradley Corporation, Menomonee, WI, (800) 272-3539.
 - 4. Brady Worldwide, Inc., Milwaukee, WI, (888) 272-3946 or (888) 250-3082 (toilet signage).
 - 5. Excel Dryer Corporation, East Longmeadow, MA, (800) 255-9235.
 - 6. Henkel Corporation, Rocky Hill, CT, (800) 624-7767 (thread lock compound).
 - 7. WingIts Innovations, LLC, Bradley Beach, NJ, (877) 894-6448 (grab bar wall fastener).
- B. Provide products by the manufacturers listed herein. No substitutions allowed.

2.2 SUPPLIERS

- A. Specified products may be procured from the following suppliers:
 - 1. Haines, Jones & Cadbury, (800) 459-7099, WMT@hjcinc.com.
 - 2. [AmeraProducts, Inc.](#) (800) 608-6568: ASI, Bradley.
 - 3. [Apex Supply Co.](#), (214) 741-5463: ASI, Bobrick.

4. Global Industrial.
5. Grab Bar Specialists: Supplies all products of this section by ASI, Bradley; 26 brands of grab bars.
6. Handy Dryer Supply: ASI, Bobrick, Excel.
7. Harbor City Supply: ASI, Bobrick, Bradley.
8. Restroom Direct: ASI, Bradley, Excel, Bobrick.
9. Sustainable Supply Co.: ASI, Bobrick, Bradley, Excel.
10. This list of suppliers is not exhaustive. Contact manufacturers for additional authorized local or national suppliers not listed.

2.3 MATERIALS

- A. Stainless Steel: AISI Type 302/304.
- B. Adhesive: Epoxy type contact cement.
- C. Thread Lock Compound (For Coat Rack Fastener): Loctite 242, by Henkel.
- D. Finishes:
 1. Chrome/Nickel Plating: Polished finish.
 2. Stainless Steel: No. 4 satin finish, unless specified otherwise.
 3. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

2.4 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from one sheet of stock, free of joints. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- C. Provide steel anchor plates and anchor components for installation on building finishes. Hot-dip galvanize ferrous metal anchors and fastening devices.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.
- E. Shop-assemble components and package complete with anchors and fittings.

2.5 SCHEDULE OF ACCESSORIES

- A. Provide products meeting the following design and performance characteristics by one of the approved manufacturers listed herein.
- B. Sanitary Napkin Disposal: Surface mount, removable 1.5 gall capacity locked waste cabinet.
 1. Fabrication: Waste receptacle, door, and cabinet 22 gauge type 304 stainless steel. Welded construction with no exposed fastening devices or exposed welded seams on cabinet.
 2. Overall Dimensions: Approx 15-in H x 11-in W x 4-in D. Verify height, width, and depth as specified by manufacturer of selected product.
 3. Push Door: Attached by concealed multi-staked piano hinges at top. Affixed with the international waste symbol.
 4. Finish: No. 4 Satin.
 5. Provide one of the following or an equivalent product by another manufacturer listed herein:
 - a. Model No. ASI 0473-1A by ASI.
 - b. Model No. 4722-15 by Bradley.
 - c. Model B-254 by Bobrick.
- C. Toilet Paper Dispensers: Surface mounted; twin jumbo roll capacity sliding access panel locked cabinet with refill indicator viewing slot.

1. Fabrication: Door, mounting plate, and cabinet 22 gauge type 304 stainless steel. Welded construction with no exposed fastening devices or exposed welded seams. High impact ABS dispensing mechanism.
 2. Overall Dimensions: Approx 20-1/2 in W x 11-3/16 in H x 5 in deep. Verify height, width, and depth as specified by manufacturer of selected product.
 3. Finish: No. 4 Satin.
 4. Provide one of the following or an equivalent product by another manufacturer listed herein:
 - a. Model No. 0039 by American Specialties.
 - b. Model No. 5425-0000, by Bradley Corporation.
 - c. Model B-2892 ClassicSeries by Bobrick.
- D. Paper Towel Dispensers, Surface Mounted: Compact arched-contour profile, lockable towel cabinet, center pull dispenser. Dispenser cabinet, door, and frame 22 gauge type 304 stainless steel.
1. Provide Model S2D-PT-2020-SM, by Stone and Steel. (Custom as supplied by HJC).
- E. Cylinder-Style Waste Receptacle, Free Standing: 55-gall capacity; Plastic, gray.
1. Provide Model 2655 Brute without lid by Rubbermaid.
- F. Electric Hand Dryers:
1. Public Toilets: Brushed stainless steel, recessed, warm-air automatic (no-touch) model, infrared activated.
 - a. Characteristics: 110V, 1240W, 20,000 rpm motor, vandal resistant heating element, manually adjustable noise, speed, and heat control mechanism.
 - b. Provide ADA-compliant recess kit.
 - c. Provide the following or an equivalent product by another manufacturer listed herein:
 - 1) Model: XL-SB Xlerator Hand Dryer and Model 40502 Recess Kit by Excel.
- G. Toilet Seat Cover Dispensers: Surface mounted (one per each water closet), 22 gage type 304 stainless steel, satin finish.
1. Model No. 0477SM, by American Specialties.
 2. Model No. B221, by Bobrick.
 3. Model No. 5831, by Bradley.
- H. Robe Hook: Surface mounted, satin stainless, by Bradley.
1. Single Robe Hook: Model No 9114.
 2. Install robe hook fastener using Thread Lock Compound specified in Part 2 above. Apply thread lock compound to fasteners in accordance with manufacturer's instructions.
- I. Towel Hook: Surface mounted, satin stainless, by Bradley.
1. Single Towel Hook: Model No 9314.
 2. Install robe hook fastener using Thread Lock Compound specified in Part 2 above. Apply thread lock compound to fasteners in accordance with manufacturer's instructions.
- J. Shower Curtain Rod: 18 gauge stainless steel, 1 inch diameter; concealed mounting of welded-on mounting flange with snap-on cover flange or escutcheon, by Bradley. Length as shown on Drawings.
1. Shower Curtain Rod: Model No 9538.
 2. Install robe hook fastener using Thread Lock Compound specified in Part 2 above. Apply thread lock compound to fasteners in accordance with manufacturer's instructions.
- K. Shower Curtain Hook: Stainless steel, by Bradley.
1. Shower Curtain Hook with Rollers: Model No 9540.
 2. Provide the required quantity in accordance with manufacturer's directions.
- L. Shower Curtain: Hook supported, white, by Bradley. Curtain size shall be 72" H x shower width+6" unless noted otherwise.
1. Antimicrobial vinyl shower curtain: Model No 9533.

- M. Grab Bars: 18 gage stainless steel; 1-1/4 inch diameter, (1-1/2 inch diameter where required by Local Code) textured grip surface; concealed mounting consisting of welded-on mounting flange with snap-on cover flange or escutcheon. Location, quantity, and length shall be as shown.
 - 1. Model No. 3700 P, by American Specialties.
 - 2. Model No. B-5806.99, by Bobrick.
 - 3. Model No. 832-2, by Bradley.
 - 4. Model No. PB23XX Series by Mainline (1-1/2 inch diameter only).
- N. Grab Bar Hollow Wall Fasteners: GBW40 stainless steel commercial grab bar fasteners manufactured by WingIts Innovations, LLC.
- O. Restroom Door Foot Operated Opener: Commercial grade T6 aluminum, surface mount, including sexed center bolt and related fasteners as supplied by manufacturer. Silver finish. Furnish the following:
 - 1. StepNPull Hands-Free Foot Operated Door Opener, (417) 295-8001, sales@stepnpull.com (HJC Item #1420113).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Use templates and rough-in measurements as required for building into wall construction.
- B. Ensure that blocking is appropriately installed and ready to receive accessories.
- C. Rough Wall Openings: Provide rough wall opening (RWO) in compliance with ADA Accessibility Guidelines, as detailed on architectural drawings, and as described in the Schedule of Accessories.

3.2 INSTALLATION

- A. Install fixtures, accessories, and items in accordance with manufacturer's instructions and as shown on Drawings. Install accessories within toilet rooms and install soap dispensers in other areas in addition to toilet rooms where shown on the drawings. Use tamper-proof fasteners.
- B. Install true, plumb, and level, securely and rigidly anchored to wall framing.
- C. Install foot operated pulls on restroom doors where shown on the drawings. Install in accordance with manufacturer's instructions using the fasteners supplied by the door pull manufacturer. Install instructional decals on inside face of door above handle.
- D. Where blocking or framing is not properly located to receive grab bars in existing hollow walls that are not modified or scheduled to receive new finishes, install grab bars using specified hollow wall fasteners. Install fasteners in accordance with fastener manufacturer's recommendations, using hole saw recommended by fastener manufacturer for type of wall construction and finish encountered.
- E. Install sealant around metal frames of mirrors, and all toilet accessories abutting FRP/NRP wall panels.

3.3 CLEANING

- A. Protection and Cleaning of Toilet Accessories and Attachment Hardware Prior to Possession.
 - 1. Immediately prior to possession, clean stainless steel accessories and attachment hardware thoroughly using soap, ammonia, or mild detergent and water. Apply with sponge or soft cloth, rinse with clear water and wipe dry. Always rub in the direction of polish lines. Rinse thoroughly with fresh water after every cleaning operation. Clean and polish to a spotless luster. Wipe dry to avoid water marks.
 - 2. Clean and polish stainless steel accessories and mirror surfaces to a spotless luster.

END OF SECTION

SECTION 11025 - LOCK BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lock box key vault for fire department emergency building access.

1.2 QUALITY ASSURANCE

- A. Pre-Installation Meetings: Meet with fire department to determine requirements for lock box type and coordinate exact location for installation and mounting of box on building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Department Lock Box:
 - 1. [Knox-Box](#) by The Knox Company, Phoenix, AZ, (800) 552-5669.
 - 2. Alternate Manufacturers: As approved by fire department.

2.2 MANUFACTURED UNITS

- A. Fire Department Lock Box
 - 1. UL labeled, weather resistant, factory finished, heavy duty steel lock box.
 - 2. Model: Type and size as required by fire department.
 - 3. Ordering: Complete manufacturer's Authorization/Order Form and obtain local fire department authorized signature on form before processing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fire department lock box at location required by fire department in accordance with manufacturers published instructions.

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END OF SECTION

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SECTION 11160 - LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Recessed dock levelers.
2. Light-communication systems (Interior and Exterior).
3. Laminated-tread dock bumpers.
4. Rain Sealing System
5. Wheel Chocks
6. Dock Reach Lights
7. Dock Reach Fans
8. Foam-Pad Dock Seals
9. Z-Guard Door Track Protection

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Review sequence of operation for each type of loading dock equipment.
3. Review coordination of interlocked equipment specified in this Section and elsewhere.
4. Review required testing, inspecting, and certifying procedures.

1.03 DEFINITIONS

A. Operating Range: Maximum amount of travel above and below the loading dock level.

B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and field connection.
3. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

- C. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
 - 2. Submittal Form: According to MH 30.1.
- D. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.08 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions slopes of driveways and heights of loading docks, by field measurements before fabrication.

1.09 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
 - b. Faulty operation of operators, control system, or hardware.
 - c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch (6 mm) between deck supports.
 - 2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
 - 3. Warranty Period for Lifting System: Five years from date of Substantial Completion.
 - 4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.
 - 5. Warranty Period for Dock Seals: Manufacturer's standard five (5) year frame warranty and two (2) year warranty against defects in materials and workmanship on the remaining components.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 RECESSED DOCK LEVELERS

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits pre-formed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Basis of Design: Subject to compliance with requirements, provide Kelley, AFX7x840:20; 4Front Engineered Solutions, Inc.:

- a. 4Front Engineered Solutions, Inc.

- B. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.
- C. Rated Capacity: Capable of supporting total gross load of 40,000 lb static load capacity minimum without permanent deflection or distortion.
- D. Platform: Not less than 3/8-inch- (9.5-mm-) thick, nonskid steel plate.
 - 1. Platform Size: Nominal 7 feet wide by 8 feet long
 - 2. Frame: Manufacturer's standard.
 - 3. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.
 - a. Toe-Guard Range: Entire upper working range.
- E. Hinged Lip: Not less than 5/8-inch- (16-mm-) thick, nonskid steel plate.
 - 1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.
- F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
 - 1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
 - a. Above Adjoining Platform: 12 inches (305 mm).
 - b. Below Adjoining Platform: 12 inches (305 mm).
 - 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
 - 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
 - 4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.
 - a. Length of Lip Extension: 20 inches (508 mm).

5. Interlock: Leveler does not operate while overhead door is in closed position leveler night lock is engaged and inflatable dock seal is not inflated. Interlock to be interactive as identified in Sequence of Operation.
- G. Air-Bag Operating System: Electric control from a remote-control station; pneumatic operation. High-volume, low-pressure lifting of ramp. Equip leveler with a packaged unit including a PVC-coated, reinforced polyester lifting bag and two-stage, single-speed electric fan of proper size, type, and operation for capacity of leveler indicated. Include dock-leveler supports controlled by release chain for lowering ramp below platform level without extending lip.
1. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
 - a. Control Station to include operation of dock fan, dock light, communication lights and dock lever as identified in Sequence of Operation.
 - b. Control Station to be able to control both light with a minimum of 0.5 amps and fan with a minimum of 8.8 amps.
- H. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
 2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- I. Materials:
1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
 3. Steel Tubing: ASTM A 500/A 500M, cold formed.
 4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- J. Dock-Leveler Finish: Manufacturer's standard finish.
1. Toe Guards: Paint toe guards to comply with ANSI Z535.1.
- K. Accessories:
1. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
 2. Self-Forming Pan (Alternate Bid): Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
 3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
 4. Side and rear brush weatherseals.
 5. Side Toe Guards: Manufacturer's Standard.
 6. Abrasive skid-resistant surface.

2.03 LIGHT-COMMUNICATION SYSTEMS

- A. General: Communication system consisting of signal-light sets, caution signs, alarms, and controls for each location indicated.
1. Basis of Design: Subject to compliance with requirements, provide the following:
 - a. APS&Go Outside; 4Front Engineered Solutions, Inc.
- B. Caution Signs: Surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows:
1. Exterior Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light.
- C. Signal-Light Sets: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel that indicates status of exterior signal lights; locate control panel at interior of dock. Provide signal-light set and control panel at each location indicated for light-communication system. Enclose signal lights in steel or plastic housing, with exterior signal-light sets equipped with sunshade.
1. Manual Operation: Lights are activated by push button or switch located on interior signal-light enclosure.
 2. Automatic Operation: Lights are activated automatically by limit switch mounted on overhead door track. Provide on-off switch located on control panel.
- Provide both Interior and Exterior Red/Green lights. Refer to section 3.07 for Sequence of Operation.
- D. Materials:
1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
 3. Steel Tubing: ASTM A 500/A 500M, cold formed.
 4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.04 DOCK BUMPERS

- A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.
1. Basis of Design: Subject to compliance with requirements, provide the following:
 - a. APS Resource, AP0426; 4Front Engineered Solutions, Inc.
- B. Laminated-Tread Dock Bumpers: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch- (19-mm-) diameter, steel supporting rods that are welded at one end to 1/4-inch- (6-mm-) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles. Weld face-plate to two steel support brackets, which shall extend back to and engage 3/4-inch- (19-mm-) diameter support rods in elongated holes, allowing steel face to float on impact.
1. Thickness: 4.5 inches (152 mm).
 2. Vertical Style: 14 inches (203 mm) wide by 20 inches (508 mm) high.

- C. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
- D. Materials: ASTM 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanized according to ASTM A 123/A 123M.

2.05 FOAM-PAD DOCK SEALS

- A. General: Dock seals consisting of fabric-covered foam pads designed to compress 4 to 5 inches (102 to 127 mm) under pressure of truck body to form an airtight seal at jambs and head of loading dock openings; of type, size, and construction indicated.
 - 1. Kelly/Entrematic DS Series, 4Front Engineered Solutions.
 - 2. Approved Alternate: DL Manufacturing, Low Compression U-Seal.
- B. Stationary Head Pad with Curtain: Square (9'-6" heights)
 - 1. Nominal size: 12 inches (305 mm) high and 2 inches (254 mm) deeper than jamb pads; sized for opening width.
 - 2. Curtain: 12 inches (305 mm) high; size for opening width.
- C. Jamb Pads – Doors greater than 8'-6" wide: Square.
 - 1. Nominal Size: 12 inches (305 mm) wide at face, 10 inches (254 mm) projection, and sized for opening height.
- D. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.
 - 1. Steel Support Frame: Manufacture's standard hot rolled steel sheet, G90 coating. All joints to be continuously welded.
- E. Materials:
 - 1. Cover Fabric: Vinyl-coated nylon or polyester with minimum total weight of 22 oz./sq. yd. (1356 g/sq. m). Lower 4 foot inside wear surface 40 oz./sq. yd. each jamb.
 - a. Color: As selected by Architect from manufacturer's full range.
 - 2. Guide Strips: Minimum 3-inch, nominal 4-inch- (102-mm-) wide, coated, nylon guide strips on jamb pads.
 - 3. Pleated Protectors: On face of jamb pads of overlapping layers of coated fabric attached to base fabric; 8-inch (203-mm) wear exposure pleats 40 oz./sq. yd. full height of each side pad and at each end of the head pad.
- F. Steel Finish: Hot-dip galvanize components to comply with the following:
 - 1. ASTM A 123/A 123M for iron and steel support framing.
 - 2. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware and anchors.

2.06 RAIN SEALING SYSTEM

- A. General: Surface-mounted system: Installs over existing dock seals and head curtain. Protects dock area from exterior moisture.
 - 1. Basis of Design: Subject to compliance with requirements, provide the following:

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- a. KELLEY, AquaShield; 4Front Engineered Solutions, Inc.
- B. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten Rain Sealing System securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
- C. Materials: ASTM 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanized according to ASTM A 123/A 123M.

2.07 ACCESSORIES

- A. Wheel Chocks for Trailer Stops: Laminated wheel chock with 15 ft min. chain. Mounting location to be approved/confirmed by Tenant.
 - 1. Basis of Design: Provide 4 Front/Entrematic, Model AP0071.
- B. Z-Guard Door Track Protection
 - 1. One (1) pair per door (48" High)
 - 2. 1/4" (Heavy Duty) thick steel
 - 3. 1/2" mounting holes for wall and floor
 - 4. Power Coated safety yellow
- C. Dock Reach Lights for Trailers: Snake arm type or mountable onto dock fan's dual articulating arm.
 - 1. LED with a minimum of 50,000 hour lamplife.
 - 2. Internal switch. Lights to include plug-in chord with a length to reach the control panel as located and attached to building structure for 120 V receptacle power.
 - 3. Low voltage wires in snake arm
 - 4. Provide one of the following:
 - a. 4 Front/Entrematic, high impact LED, mountable onto 6-inch tall steel pipe bollard (0.12 amps).
 - b. DL Manufacturing, Model 450 Versa Light (0.5 amps)
 - c. Alternate: 4 Front/Entrematic, high impact LED, mountable onto 4 Front/Entrematic dock fan arm (0.15 amps)
- D. Dock Reach Fans for Trailers:
 - 1. Dock fan with minimum 1200 CFM output.
 - 2. Integral switch. Fans to include plug in chord with a length to reach the control panel as located and attached to the building structure for 120 V receptacle power.
 - 3. Mount: Dual articulating 40-inch or longer arm or slide & swivel swing 24-inch arm that mounts to building wall.
 - 4. Provide the following:
 - a. 4 Front/Entrematic, Model TurboES (3.0 Amps)

2.08 FINISH REQUIREMENTS

- A. Finish loading dock equipment after assembly and testing.
- B. Galvanizing: Hot-dip galvanize components to comply with the following:
 - 1. ASTM A 123/A 123M for iron and steel loading dock equipment.
 - 2. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.

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- C. Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
- B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- C. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.
- D. Place self-forming pan system for recessed dock levelers in proper relation to loading platform before pouring concrete.
- E. Clean recessed pits of debris.

3.03 INSTALLATION

- A. General: Install loading dock equipment as required for a complete installation.
 - 1. Rough-in electrical connections.
- B. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
- C. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
 - 1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
 - 2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
- D. Rain Sealing System: Attach support frames securely to building structure in proper relation to door openings, and dock seals to ensure proper alignment.

3.04 ADJUSTING

- A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
- B. Test dock levelers for vertical travel within operating range indicated.
- C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.05 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

3.07 SEQUENCE OF OPERATION

- A. Dock Leveler: Dock control panel shall automatically control and interlock the dock communication lights (interior and exterior), leveler, fan and light. The total electrical load for all dock equipment shall not exceed the capacity of a single 120v volt, 20 amp circuit at any time during operation. Control sequence shall be as outlines below:

1. Control Sequence:

- a. Dock Door Closed
 - 1) Outside communication light is green. Inside communication light is red green.
 - 2) Dock light and dock fan are off.
 - 3) Dock leveler is disabled.
- b. Dock Door leaves the closed position
 - 1) Outside communication light transitions to red. Inside communication light transitions to red green.
- c. Dock Door Open
 - 1) Door position sensor senses door is open.
 - 2) Outside communication light is red. Inside communication light is red green
 - 3) Dock light and dock fan automatically turn on.
 - 4) Dock leveler is enabled and can be operated with leveler control.
 - 5) While the dock leveler is being cycled, the dock fan and dock light are automatically disabled.
 - 6) After the leveler is fully cycled, the dock fan and dock light are automatically enabled.
 - 7) Outside communication light is red. Inside communications light is green.
- d. Loading Operation Completed
 - 1) Dock leveler is cycled to stored position.
 - 2) Outside communication light is red. Inside communication light is red green
- e. Closing Dock Door
 - 1) Dock door leaves the opened position - dock fan, light and leveler operation is disabled.
 - 2) Dock door fully closes, door position sensor senses door is closed.

- 3) Outside communication light green. Inside communication light is red green

END OF SECTION

SECTION 12490 - SECURITY FILM WINDOW LAMINATE

PART 1 - GENERAL

1.1 SCOPE

- A. This Section provides for the furnishing and installing of security film window laminate at selected windows as shown on Drawings.

1.2 SUBMITTALS

- A. Product Data: Submit product data indicating material specifications, characteristics applicable for each glass type to receive film laminate, and instructions for using adhesive and sealant.
- B. Field Samples:
 - 1. Submit two (2) samples, 12 inches by 12 inches in size, illustrating security film laminate material and adhesives.
 - 2. Submit 12 inch long bead of film perimeter sealant; black color.
- C. Maintenance Data: Submit maintenance data including recommended cleaning and stain removal methods.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the job site with the manufacturer's labels intact and legible.
- B. Store and protect security film materials according to manufacturer's written instructions. Prevent damage to film materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.4 WARRANTY

- A. Film laminate shall be warranted by the specified manufacturer for a period of ten (10) years after application to maintain shatter-resistant properties without cracking, hazing, peeling, or discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Subject to compliance with requirements, provide CD 335 Max Pro Series Film window laminate by Clear Defense, Inc.; (336) 370-1699 or comparable products by one of the following:
 - 1. Clear Defense, Inc.
 - 2. 3M
 - 3. Llumar
 - 4. Armor Glass
 - 5. SolarGard (Saint-Gobain Performance Plastics Corporation)
 - 6. (Or) Approved Equal

2.2 MATERIALS

- A. Basis of Design Product: Provide products from manufacturers above aligning with the basis of design indicated below.
 - 1. Provide CD 335 Max Pro Series security film window laminate in clear finish. Each sheet shall consist of three (3) layers of optically clear 100 micron P.E.T. with a 23.5 micron mounting adhesive, 11.7 micron laminating adhesive, and a 0.25 micron acrylic abrasion-resistant surface coating for a total thickness of 14 mils.
 - 2. Provide Safety S140, 3-Ply film, from 3M, with a minimum 14 mil thickness.

3. Provide 14 Mil Clear Armorcoat from Solar Gard (Saint-Gobain Performance Plastics Corporation)
 - B. Mounting adhesive shall be protected by a 25 micron thick polyester release liner.
 - C. Adhesive System: Manufacturer's standard high mass acrylic, pressure sensitive adhesive system, applied uniformly.
 - D. Sealant: Dow Corning 995 Silicone Structural Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass surfaces to receive new film laminate and verify that they are free from defects and imperfections affecting the performance or final appearance of the application. Correct all deficiencies before starting film laminate application.

3.2 PREPARATION

- A. Clean windows and window framing thoroughly with a neutral cleaning solution. Inside surface of window glass shall be bladed with industrial razors to insure the removal of foreign contaminants.
- B. Place towels or other absorbent material on the window sill or sash to absorb moisture accumulation generated by the film application.

3.3 APPLICATION

- A. Apply film laminate in strict accordance with the instructions and recommendations of the specified manufacturer including, but not limited to, cutting, positioning, and silicone beading around window perimeter.
- B. Refer to Drawings for windows to receive the security film laminate.

3.4 CLEANING

- A. Clean finished film application with materials and within the time frame recommended by the manufacturer.

END OF SECTION

SECTION 12492 – ALUMINUM HORIZONTAL BLINDS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section provides for the furnishing and installing of aluminum horizontal blinds at selected windows as shown on Drawings.

1.2 SUBMITTALS

- A. Product Data: Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for window treatments.
- B. Shop drawings:
 - 1. Shop drawings: Indicate field-measured dimensions of opening which are to receive blinds, details on mounting surface and sill conditions, and details of corners and conditions between adjacent blinds.
 - 2. Color samples: Submit a sample of each type and color of material specified.
- C. Maintenance Data:
 - 1. For window treatments to include in maintenance manuals.
 - 2. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 3. Window treatments: Full-size units equal to 5 percent of quantity installed for each size and color material indicated, but no fewer than two units

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.
- B. Store product in clean, dry areas indoors, in manufacturer's unopened packaging, laid flat to prevent sagging and twisting until ready for installation, in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

1.4 WARRANTY

- A. Limited Lifetime Warranty per manufacturer standard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.
- B. Basis of Design:
- C. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
 - 1. Width: 1 inch
 - 2. Thickness: Manufacturer's standard.
 - 3. Spacing: Manufacturer's standard.

- D. Headrail: Formed .025 min thick, painted steel; U-shaped rolled edges. Headrails fully enclose operating mechanisms on three sides.
 - 1. Capacity: One blind per headrail unless otherwise indicated.
 - 2. Ends: Manufacturer's standard.
 - 3. Manual Lift Mechanism:
 - 4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tile/Full
 - b. Operator: Corrosion-resistant steel rod
 - c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.
 - 5. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.
 - 6. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard.
- E. Bottom Rail: Formed-steel tube that secures and protects ends of ladders and lift cords and has molded clear plastic-capped ends with integral protrusions to prevent bottom bar from marring window sills and mullions.
 - 1. Type: Manufacturer's standard.
- F. Lift Cords: Manufacturer's standard braided cord.
- G. Ladder Slat Supports: Evenly spaced across headrail at spacing that prevents long-term slat sag.
 - 1. Type: Braided polyester yarn dyed to manufacturer's color standards
- H. Valance: Manufacturer's standard.
- I. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - 1. Type: Inside Top Mount
 - 2. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
- J. Colors, Textures, Patterns, and Gloss
 - 1. Slats: Raw Umber or Low Gloss Black
 - 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units in accordance with manufacturer's written instructions.
 - 1. Locate so exterior slat edges are not closer than 1 inch (25 mm) from interior faces of glass and not closer than 1/2 inch (13 mm) from interior faces of glazing frames through full operating ranges of blinds.
 - 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 - 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING

- A. Clean horizontal louver blind surfaces after installation in accordance with manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

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END OF SECTION

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SECTION 12500 - FURNITURE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Furniture and Accessories.

PART 2 - PRODUCTS

2.1 FURNITURE AND ACCESSORIES

A. Procurement:

- 1. Furnishings provided by General Contractor Through Walmart Preferred Vendor.

B. Manufacturer:

- 1. Herman Miller (preferred Manufacturer).
 - a. Contact:
Mark Bormann
Senior Interior Designer & Account Manager
John A. Marshall Co. (preferred Vendor)
123 W 11th Street
Tulsa, OK 74119
M: 918-671-3359
Mark.Bormann@jamarshall.com

C. Alternate Manufacturer

- 1. HON : Open line alternate for pricing per budget constraints.
 - a. THE HON Company
200 Oak Street
Muscatine, Iowa 52761

D. Products:

- 1. Refer to drawings for schedule of selections and quantity.

PART 3 - EXECUTION (Not Used)

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END OF SECTION

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SECTION 14210 - ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes electric traction hospital service elevators.

1.02 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.03 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, controller closet coordination, relationships with other construction, and locations of equipment.
 - 2. Include large-scale layout of car-control station.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
 - 4. Preliminary elevator shop drawings must be provided to the project Architect and Structural Engineer for review prior to the review and approval of the elevator shaft foundation and precast wall shop drawings. At a minimum the preliminary shop drawings shall contain the following:
 - a. Shaft dimensions and tolerances
 - b. Rough opening dimensions
 - c. Foundation and wall reactions
 - d. Electrical loads
 - e. Ventilation requirements
 - 5. Final elevator shop drawings must be provided to the project Architect for review and approval prior to the final equipment order. Changes from the preliminary elevator shop drawings may not be approved if they affect the shaft design.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.
- E. Renderings or color photographs of the provide features and materials of the cab front wall.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and controller closet layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.08 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, and pits.

1.09 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: One year from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide Twelve (base bid) and an additional forty-eight (alternate bid) months' full maintenance service by skilled employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.
 - 1. Include 24-hour-per-day, 7-day-per-week emergency callback service with two-hour response time.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approved Products: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. TK Elevator: Evolution Series. <https://www.tkelevator.com/us-en/>
 - 2. KONE Elevator Corporation: MonoSpace Series. <https://www.kone.com/en/>
 - 3. Otis Elevator Company: Gen2 Series. <https://www.otis.com/en/us/>
 - 4. Schindler Elevator Corporation: 3300 Series. <https://group.schindler.com/en.html>
- B. Basis-of-Design: Elevator shaft layout and design shown on drawings is based on the following suppliers and elevator models:
 - 1. Office/Service elevator: Schindler 3300XL MRL Traction Elevator
 - 2. Parking Lot Tower elevator: Schindler 3300 MRL Traction Elevator
 - 3. Alternative selection: Selection of an alternate supplier and/or model is permitted but will require the elevator shaft design to be reviewed and updated by the project Architect and Structural Engineer.
- C. Source Limitations: Obtain elevators from single manufacturer.
 - 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 3 or greater in ASME A17.1/CSA B44.
- D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

2.03 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Office/Service Elevator Description: Passenger/Hospital Service Elevator
 - 1. Machine Location: Machine Room.
 - 2. Machine Type: Gearless traction.
 - 3. Rated Load: 4500 lbs.
 - 4. Rated Speed: Minimum 150 fpm.
 - 5. Operation System: Single Car.
 - 6. Auxiliary Operations:
 - a. Battery operated lowering.
 - b. Nuisance call cancel.
 - 7. Car Enclosures:
 - a. Inside Width: 67 inches (2032 mm) from side wall to side wall.
 - b. Inside Depth: 97 inches (1651 mm) from back wall to front wall (return panels).
 - c. Inside Height: Minimum 108 inches to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, vandal resistant
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Wall Panels Base Bid: Manufacturer standard upgraded stainless steel vandal resistant panels.
 - g. Door Faces (Interior): Satin stainless steel, vandal resistant.
 - h. Door Sills: Aluminum, mill finish.
 - i. Ceiling: Polished stainless steel, No. 8 finish, with LED lights.
 - j. Handrails: Manufacturer standard flat bar, satin stainless steel, No. 4 finish, at sides and rear of car.
 - k. Floor prepared to receive finished flooring as part of separate Bid Package. No more than 3/4 inch thick and less than 800 lbs.
 - 8. Hoistway Entrances:
 - a. Width: 48 inches.
 - b. Height: 84 inches.
 - c. Type: Front entrance - Two-stage side opening.
 - d. Frames: Satin stainless steel, vandal resistant finish.
 - e. Doors: Satin stainless steel, vandal resistant
 - f. Sills: Aluminum, mill finish.

9. Hall Fixtures: Satin stainless steel, No. 4 finish.
10. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

C. Parking Tower Elevator Description: Passenger Elevator

1. Machine Location: Machine Room.
2. Machine Type: Gearless traction.
3. Rated Load: 3500 lbs.
4. Rated Speed: Minimum 150 fpm.
5. Operation System: Single Car.
6. Auxiliary Operations:
 - a. Battery operated lowering.
 - b. Nuisance call cancel.
7. Car Enclosures:
 - a. Inside Width: 67 inches (2032 mm) from side wall to side wall.
 - b. Inside Depth: 97 inches (1651 mm) from back wall to front wall (return panels).
 - c. Inside Height: Minimum 108 inches to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, vandal resistant
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.
 - f. Wall Panels Base Bid: Manufacturer standard upgraded stainless steel vandal resistant panels.
 - g. Door Faces (Interior): Satin stainless steel, vandal resistant.
 - h. Door Sills: Aluminum, mill finish.
 - i. Ceiling: Polished stainless steel, No. 8 finish, with LED lights.
 - j. Handrails: Manufacturer standard flat bar, satin stainless steel, No. 4 finish, at sides and rear of car.
 - k. Floor prepared to receive finished flooring as part of separate Bid Package. No more than 3/4 inch thick and less than 800 lbs.
8. Hoistway Entrances:
 - a. Width: 42 inches.
 - b. Height: 84 inches.
 - c. Type: Front and Rear entrance, Two-stage side opening.
 - d. Frames: Satin stainless steel, vandal resistant finish.
 - e. Doors: Satin stainless steel, vandal resistant
 - f. Sills: Aluminum, mill finish.
9. Hall Fixtures: Satin stainless steel, No. 4 finish.
10. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.04 TRACTION SYSTEMS

- A. Elevator Machines: The hoisting machine shall be a compact Gearless traction type, consisting of AC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway.
 - 1. Machine shall be permanent magnet AC gearless traction type.
 - 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 - 3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
 - 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
 - 5. A large diameter, forged shaft to serve as a support for the motor armature and for the removable drive sheave and brake system.
 - 6. Supported by roller bearings mounted in the machine housing.
 - 7. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) Non Regenerative or Regenerative.
 - 8. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two step process to a variable voltage variable frequency power supply for use by the hoist motor.
 - 9. The speed control shall be by means of vector control providing independent excitation and torque current. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 05 50 00 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Bolted- or welded-steel units.
- F. Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.
- G. Guides: Roller guides, with a minimum of three tires, shall be mounted on top and bottom of the car and counterweight frame and be held in contact with the guide rail by adjustable devices.
- H. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- I. Brake:
 - 1. The brake shall be a spring applied electric brake, held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.

- J. Ropes:
1. Provide Steel hoist cables of size and number to ensure proper wear qualities shall be used. Special wedge shackles shall be used.
 2. Governor ropes shall be of iron construction
 3. Any special tools, devices, software or equipment required for monitoring the wear of any means of suspension other than standard elevator steel cables shall be included with the installation of the equipment and become the property of the owner at time of elevator completion. This includes special ongoing monitoring systems, special tools and instruction needed to monitor the suspension system.
- K. Counterweight:
1. Counterbalance each elevator for smooth and economical operation by using iron or steel plate weights securely fastened in a steel counterweight frame. Counterweight shall equal the weight of the complete elevator car and approximately 40-45 percent of the specified capacity load.
- L. Safety and Governor:
1. Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.
- M. Emergency Terminal Limits:
1. Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.
- N. Automatic Self-Leveling:
1. Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- O. Sound Reducing: Provide sound reducing materials to effectively isolate the elevator equipment from floors and structure.
1. Control system shall be arranged to eliminate mechanical vibration, airborne noise and structurally transmitted vibrations from control generated power transients.
- P. Elevator Pit Ladder: Fabricate elevator pit ladder ladders with dimensions, spacings, details, and anchorages as required.
1. Comply with ASME A17.1.
 2. Siderails: Continuous, 1/2-by-2-1/2-inch (12-by-64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.
 3. Bar Rungs: 3/4-inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.
 4. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
 5. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

2.05 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Single Car Operation: Provide single car operation.
- C. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 1. Battery-Powered Lowering: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are lowered one at a time to the next floor below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.
 - a. If automatic detection systems signal the presence of smoke or fire on the lowest floor level with direct exits, battery-powered lowering shall be to the next closest level.
 2. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
- D. Traveling Cable: Provide traveling cable from each car to location of control panel for integration with owners access control system.
 1. Provide rough-in for owner provided and installed proximity reader in each car.

2.06 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.07 CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
 1. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8-inch (22.2-mm) nominal thickness.
 2. Floor Finish: To be bid separately.

3. Wall Panels Base Bid: Manufacturer standard upgraded vandal resistant stainless steel wall panels.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from vandal resistant stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
9. Metal Ceiling: Flush panels, with LED downlights in the center of each panel. Align ceiling panel joints with joints between wall panels.
10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.08 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
 1. Fire-Protection Rating: As noted on Drawings, with 30-minute temperature rise of 450 deg F (250 deg C).
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
 1. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
 2. Stainless-Steel Frames: At all passenger entrances on all floors, formed from stainless-steel sheet.
 3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both inside surfaces of hoistway door frames.
 4. Stainless-Steel Doors: At all passenger entrances on all floors, hollow-metal construction; fabricated from stainless-steel sheet.
 5. Sight Guards: Provide sight guards on doors matching door edges.
 6. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 7. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.09 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
 1. Provide vandal resistant buttons
- B. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation.
 - a. Provide manufacturers standard upgraded vandal resistant buttons.
 2. Mark buttons and switches for function. Use both tactile symbols and Braille.
 3. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
 4. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)."
 5. Provide full-width wrap around hinged car operating panel with integral column and filler panel.
 6. All components in the car control stations are to be mounted flush with the front wall panels and are to be constructed of the same material as the front wall panels. Surface mounted and plastic trimmed faceplates are not allowed.
- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- E. Hall Push-Button Stations: Provide one hall push-button station at each landing.
1. Provide units with flat, trimless faceplate for mounting with body of unit recessed in wall.
 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
 3. Equip units with buttons for calling elevator and for indicating direction of travel or destination as required by system. Provide a signaling system to verify floor selection, where destination registration is required, and to direct passengers to appropriate car.
 4. Provide manufacturers standard upgraded decorative "rimlight" fixtures.
- F. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign integral with hall push-button station unless otherwise indicated.
1. Refer to ASME A17.1, Appendix O "Elevator Corridor Call Station Pictograph".
 2. Provide manufacturers standard upgraded decorative "rimlight" fixtures.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
1. Place lanterns either above or beside each hoistway entrance, as directed by architect. Mount at a minimum of 72 inches above finished floor.
 - a. Provide alternate bid to place hall lanterns in-car.

2. Provide units with flat, trimless faceplate for mounting with body of unit recessed in wall.
3. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

a. At manufacturer's option, audible signals may be placed on each car.

H. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoistway auxiliary entrance at ground floor only when required by code. Otherwise, provide hall lantern only. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

2.10 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Stainless-Steel Bars: ASTM A 276, Type 304.
- E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- G. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 2. Comply with the National Electrical Code for electrical work required during installation.

- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Comply with manufacturer's written instructions.
- E. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- F. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- G. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- H. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- I. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.
- J. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- K. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - 2. Place hall lanterns either above or beside each hoistway entrance.
 - 3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.
- L. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

3.03 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load each elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.04 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.06 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Perform emergency callback service during normal working hours with response time of two hours or less.
 - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

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DIVISION 20 - SEISMIC CONTROLS FOR MEFPT SPECIFICATION

17100 (200548) Seismic Controls for MEP/F/T Systems

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SECTION 17100 (200548) - SEISMIC CONTROLS FOR MEP/F/T SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. This section includes requirements for seismic controls to be installed for project, the design for which is a delegated design responsibility.

1.2 DEFINITIONS

- A. Section Title: Seismic Controls for Mechanical, Electrical Plumbing, Fire Protection, and Technology (MEP/F/T) Systems.
- B. IBC: International Building Code.
- C. ICC-ES: ICC-Evaluation Service.
- D. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. The contractor shall be responsible for determining the requirements for seismic control measures to be applied to HVAC piping and equipment, electrical conduit and raceways, electrical switchgear and plumbing systems specified herein. Seismic protection criteria used to determine seismic control requirements of all mechanical, electrical and plumbing systems shall be determined by the applicable code adopted in the project jurisdiction. Where not already determined within the contract documents, the contractor shall be responsible for contracting a licensed professional engineer to establish building site class, seismic use group, occupancy category, seismic design category, seismic zone or any other criteria necessary to determine the requirements for seismic control measures for mechanical, electrical and/or plumbing systems.
- B. Where required, the Contractor shall be responsible for determining the type and location of seismic supports required for the HVAC piping and equipment, electrical conduit and raceways and plumbing elements shown on the contract drawings based on the seismic criteria, the size and weight of the supported element and the distance from structure that the element will be installed. The Contractor shall submit shop drawings as defined in Paragraph "Submittals" showing the types and locations of required seismic supports.
- C. The requirements for seismic control measures to be applied to HVAC piping and equipment, electrical conduit and raceways, electrical switchgear and plumbing systems specified herein are in addition to any other items called for in other sections of these specifications. All anchor connections to structure for support of mechanical/electrical equipment, regardless of the need for seismic restraints, shall be shown on shop drawings and submitted for review by the Engineer of Record.
- D. At the Contractor's option, use pre-engineered seismic restraints produced by the manufacturers specified in part 2.1 of this section. Spacing of seismic restraints may be modified in these pre-engineered systems to meet seismic design parameters when properly engineered and documented.
- E. All seismic restraints, isolators, and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.

- F. Seismic protection systems shall be installed in strict accordance with all applicable local, state, and/or federal codes. Installation shall also be in strict accordance with component manufacturer's requirements and standards and with industry construction standards. Whenever conflicts occur between codes or standards, the most stringent shall apply.
- G. Seismic protection of fire protection piping systems shall be installed in strict accordance with the provisions of NFPA 13 (2010 or later edition).

1.4 SUBMITTALS

- A. Seismic Control Measure Analysis: The contractor shall provide an analysis determining the requirement or exemption for seismic control measures for mechanical, electrical and plumbing equipment. The analysis shall be signed and sealed by a licensed professional structural engineer.
 - 1. The analysis shall at a minimum include the following:
 - a. For projects permitted under Uniform Building Code
 - 1) UBC Seismic Zone
 - 2) Seismic Zone Factor
 - 3) Occupancy Category
 - b. For projects permitted under International Building Code
 - 1) Seismic Use Group or Building Category.
 - 2) Seismic Design Category
 - 3) Site Class
 - 4) Design Spectral Response Acceleration Values
 - c. For projects with equipment mounted outdoors and subject to wind restraint requirements:
 - 1) Basic Wind Speed.
 - 2) Building Classification Category
 - 3) Minimum 10lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Where seismic control measure analysis determines seismic controls are not required:
 - 1. Submit report that summarizes the analysis for review and approval.
 - 2. Disregard the remaining portions of this submittal section
- C. Where seismic control measure analysis determines seismic controls are required:
 - 1. Submit report that summarizes the analysis for review and approval
 - 2. Provide submittals for seismic bracing as required in the remaining portions of this submittal section.
- D. Product Data: The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- E. Delegated-Design Submittal: Submit seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators and seismic restraints.

- a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other sections for equipment mounted outdoors.
 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 3. Seismic and Wind Restraint Details:
 - a. Design Analysis: Submit report that supports selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: Where required provide preapproval documentation from an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- F. Shop Drawings: The following items shall be signed and sealed by a registered professional engineer:
1. Shop drawings along with catalog cuts, templates, erection, and installation details, as appropriate, for the items listed below shall be submitted for approval. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to other building systems and construction.
 - a. Sway Braces
 - b. Flexible Couplings or Joints
 - c. Resilient Type Vibration Devices
 - d. Equipment Anchor Connections
 - e. Fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
 - f. Details of suspension and support for ceiling hung equipment.
 - g. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
 - h. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
 2. Layout drawings showing locations and types of seismic restraints for all equipment, ductwork, piping and conduit shall be submitted. Locations for seismic restraints shall be coordinated with the structure and with other mechanical and electrical components. Coordinate types of restraints with the submitted schedule
 3. Indicate components exempt from seismic due to exceptions for component importance factor, component response modification factor, component amplification factor, seismic design category, etc.
- G. Seismic Certification and Analysis:
1. Seismic restraint calculations shall be provided for all connections of equipment to the structure. Calculations shall be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the project location.
 2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Testing and calculations shall include shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
 3. Analysis shall indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without

failure, the code required forces acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

4. Submit certification letter stating that the special inspector has received the factory training necessary to perform the field inspection specified in Part 3 of this specification.

H. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Professional Engineer Qualifications (Analysis): The professional engineer shall be licensed to practice in the jurisdiction where the project is located and shall be experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for building structural and seismic requirements.
- B. Professional Engineer Qualifications (Design): The professional engineer shall be legally qualified to practice in the jurisdiction where the Project is located and shall be experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- D. Seismic Restraint Manual: A seismic restraint manual shall be prepared that contains the basis of the design for the seismic support systems, product data, shop drawings and layout drawings. A copy of the seismic restraint manual shall be kept on the jobsite for the duration of the project.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- G. Comply with NFPA 70.

1.6 SPECIAL INSPECTION

- A. Requirements specified herein for special inspection of important aspects of the seismic design are in addition to other requirements specified in other sections of this specification.

1.7 HVAC EQUIPMENT

- A. HVAC equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
 1. Mechanical Equipment including but not limited to:
 - a. Boilers
 - b. Expansion Tanks
 - c. Heat Rejection Equipment
 - d. Refrigerant Compressors

- e. Indoor Air Handling Equipment
 - f. Rooftop Air Handling Equipment
 - g. Packaged Rooftop Units
 - h. HVAC Piping and Equipment Storage Racks
 - i. Heat Exchangers
 - j. Water Chillers
 - k. Cooling Towers, Fluid Coolers, Condensing Equipment
 - l. Control Panels
 - m. Pumps with Motors
- 2. HVAC (hydronic) Piping Systems
 - 3. HVAC Ductwork Systems

1.8 ELECTRICAL EQUIPMENT

- A. Electrical equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
 - 1. Major Electrical Distribution Equipment including but not limited to
 - a. Panelboards
 - b. Generators
 - c. Switchgear
 - d. Motor Control Centers
 - e. Transformers
 - f. Freestanding Disconnect
 - g. Control equipment (time-clocks, contactor enclosures, etc.)
 - 2. Electrical Conduit and Raceways
 - 3. Electrical Bussways

1.9 PLUMBING EQUIPMENT

- A. Plumbing equipment to be protected shall include the following items to the extent required on the drawings or in other sections of these specifications:
 - 1. Plumbing Equipment including but not limited to
 - a. Water Heaters
 - b. Heat Exchangers
 - c. Water Softeners
 - d. Expansion Tanks
 - e. Air Compressors
 - f. Vacuum Pumps
 - g. Pumps with Motors
 - 2. Fuel Gas piping
 - 3. Fuel Oil Piping
 - 4. Medical Gas Piping

1.10 RELATED WORK

- A. Housekeeping Pads
 - 1. The restraint vendor shall prepare housekeeping pad reinforcement and monolithic pad attachment to the structure details and design..
 - 2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
- B. Supplementary Support Steel

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc., as required or specified.

1.11 ATTACHMENTS

- A. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic vendor's calculations.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Seismic Restraints: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following or approved equals:
 1. Amber/Booth Company, Inc.
 2. B-Line / Tolco.
 3. International Seismic Application Technology (ISAT).
 4. Kinetics Noise Control, Inc.
 5. Loos & Company, Inc.
 6. Mason Industries, Inc.
 7. Uni-Strut.
 8. Vibro-Acoustics.
- B. Flexible Couplings: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following or approved equals:
 1. Barco Div.
 2. Flexonics, Inc.
 3. Hispan.
 4. International Seismic Application Technology (ISAT).
 5. Mason Industries, Inc.
 6. Resistoflex.

2.2 VIBRATION ISOLATORS

- A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
 1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
 2. Fiberglass or cork isolator pads: molded cork or glass fiber not less than 1 inch thick and pre-compressed through 10 compression cycles at 3 times the rated load.
 3. Load range: from 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.
- B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.
- C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 1.0 times the rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to the structural design criteria. Contact the Engineer if design criteria is not shown on the drawings.
 6. Top Plates: Provide threaded studs for fastening and leveling equipment.
 7. Finishes: Manufacturer's standard corrosive-resistant finish.
- D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.
- F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Install elastomeric grommet at bottom connection for isolation between anchor bolt and base plate or housing.
 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 SEISMIC CONTROLS

- A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.
- B. Manufactured Seismic Snubbers: All-directional snubbers.
1. Construction: Interlocking steel members restrained by a 3/4-inch- thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

- C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.
 - 1. Construction: Welded steel shapes conforming to ASTM A 36.
 - 2. Resilient Components: 3/4-inch thick, replaceable, shock-absorbing neoprene insert.

2.4 VIBRATION ISOLATION BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
 - 1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
 - 2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
 - 3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
 - 4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
 - 5. Configure inertia bases to accommodate equipment supported.
 - 6. Pump Bases: Size to support pump and piping elbows.
 - 7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.5 VIBRATION ISOLATION ROOF CURBS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.
- B. Components: Upper support frame; lower support assembly; freestanding, unhooused, laterally stable steel springs; vertical and horizontal restraints.
 - 1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer strip for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
 - 2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

2.6 MATERIALS

- A. Bolts and Nuts:
 - 1. Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B18.2.2, and ASTM A307 or A 576.
 - 2. Bolts, underground, ASTM A 325.
- B. Sway Brace: Except for pipes, material shall be structural steel conforming to ASTM A 36. Steel pipes shall conform to ASTM A 501.
- C. Flexible Couplings: Flexible couplings shall have same pressure ratings as adjoining pipe. Where required by these specifications, flexible couplings shall be one of the following:

1. Flexible ball joints conforming to the following requirements may be employed on aboveground piping. Joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement. Joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.
2. Flexible metal hose type joints may be used for aboveground or underground piping, up to 8" pipe diameter. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

D. Resilient Vibration Isolation Devices:

1. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as in paragraph "Anchor Bolts".
2. Multidirectional Seismic Snubbers: Multidirectional seismic snubbers employing elastomeric pads shall be installed on all floor or slab-mounted equipment. Snubbers shall provide 0.25 inches vertical and horizontal clearances. Vertical forces shall be resisted by the snubber medium. Provide additional structural steel supports/frame necessary for equipment to insure proper restraint.
3. Seismically Restrained Vibration Isolators: As an option to multidirectional seismic snubbers, a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions may be utilized. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer, neoprene or equal, to protect equipment.
4. Restraints shall allow a maximum of 1/4" movement before engaging and shall not interfere in normal operation. Housing shall allow for visual inspection of the spring. The entire assembly shall have a certified minimum rating of 1g. in all directions. Submit test data from independent testing lab.
5. Isolator shall be stable spring with a minimum K_y/K_x of 1.0 and the spring shall be isolated from the housing by an internal elastomeric pad on its base for sound absorption. Spring shall have a combination leveling bolt and equipment fastening device. Nuts and bolts shall be zone-electroplated to prevent corrosion. Adjusting bolt and equipment attachment shall have a minimum rating of 1g. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed.
6. Baseplate shall have adequate means for bolting to the structure. If elastomeric pad for sound absorption is on baseplate of housing, anchor bolts shall be isolated with elastomeric grommets.

2.7 CABLE RESTRAINT

- A. Restraint assembly for suspended equipment, piping and ductwork consisting of galvanized steel aircraft cable attached to galvanized steel thimbles or steel assemblies with two clamping bolts. Thimbles or assemblies shall be specifically designed for cable service, shall be able to swivel to final installation angle and shall be securely fastened to the equipment or equipment base and the building structure. Cables shall be sized for the force required per code with a minimum safety factor of 2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Install and anchor seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.
2. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
3. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.
4. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete, and trowel to a smooth, hard finish.

5. Install pipe connectors at connections for equipment supported on vibration isolators.
6. Install cables to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

B. Sway Braces for Piping, Conduit and Ducts

1. Sway braces shall be installed on piping, conduit and HVAC ducts to preclude damage during seismic activity. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 1/2 inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.
2. Sway Braces for Piping and Conduit:
 - a. Horizontal Runs: Provide transverse and longitudinal sway bracing at intervals as required for the pipe size and seismic zone.
 - b. Vertical Runs: Vertical runs of piping 1-1/2" or greater diameter shall be braced at not more than 10-foot vertical intervals. For piping smaller than 1-1/2" diameter, bracing shall be provided at no more than 4-foot spacing.
 - c. Anchor Rods, Angles, and Bars: Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in place concrete or masonry insert of clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in Table III.
 - d. Clamps: Clamps on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp.
 - e. Bolts: Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.
3. Sway Braces for HVAC Ducts:
 - a. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each duct run, and otherwise at intervals as required for duct size and seismic zone. Walls which ducts penetrate may be considered transverse braces.
 - b. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at intervals as required for duct size and seismic zone. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and it is sized for the larger duct.

C. Piping and Conduit Penetration Requirements

1. All piping from 1 to 3-1/2 inches diameter shall be installed with 1" clearance on all sides and at every floor, and masonry or concrete wall penetration. A 2" clearance is required for pipe sizes larger than 3-1/2".
2. Insulated and uninsulated pipes and conduit passing through walls and partitions (except smoke and fire walls and partitions) shall be run through not less than No. 12 gauge steel pipe sleeves finishing flush with the finished wall surfaces. Where covered pipes pass through the walls or partitions, same shall be centered in steel pipe sleeves. All sleeves or thimbles shall be independent of the pipes they enclose and centered in sleeves to insure free movement of the pipes without injury to pipe insulation, wall or other finish. Caulk around all pipes and pipe sleeves passing through walls or ceilings with untarred jute and make airtight and soundproof.
3. Insulated and uninsulated pipes and conduit passing through fire, or fire and smoke walls and partitions shall be run through rated wall sleeve assemblies sealed with Hilti CS-240 firestop sealant or approved equal UL approved sealant meeting the approval of the authority having jurisdiction and as indicated on details on drawings.
4. Pipe sleeves through outside walls shall be Schedule 40 steel pipe sleeves with 1-1/2" collar welded to center of sleeve and cast in wall. Caulk between sleeves and pipes and make watertight.
5. Materials and equipment shall conform to the respective specifications and other requirements specified below:

D. Spreaders

1. Provide spreaders between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart or four times the maximum displacement due to seismic force. Spreaders to be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.

E. Flexible Couplings or Joints

1. Building Piping: Flexible couplings or joints in building piping shall be provided in the following locations on pipe risers:
 - a. Within 24 inches of the top and bottom of all risers. This requirement may be deleted in risers less than 3 ft. in length, and in risers 3 to 7 ft. in length, one flexible coupling is adequate.
2. Underground Piping: All underground piping and 4-inch or larger conduit, except heat distribution system, shall have flexible couplings installed adjacent to building. Additional flexible couplings shall be provided as follows:
 - a. On each side of the joints of demarcation between soils having widely differing degrees of consolidation.
 - b. At all points that can be considered to act as anchors.
 - c. On every branch of a tee and each side of an elbow.

F. Anchor Bolts

1. All floor or pad mounted equipment required by any Section of these specifications shall use cast-in-place or female wedge type anchor bolts. Anchor bolts must conform to ASTM A 307. Female wedge anchors shall have an evaluation report number from ICBA Evaluation Service. Anchor bolts shall have an embedded straight length equal to at least twelve times nominal diameter of the bolt. If the size and number of the anchor bolts are not shown on the drawings, then anchor bolts shall conform to the applicable codes and standards for the various equipment weights or the manufacturer's installation recommendations, whichever is the most stringent.

G. Equipment Sway Bracing

1. Provide for all items supported from overhead floor or roof structures with the following requirements:
 - a. Braces shall consist of angles, rods, bars, or pipes secured at both ends with not less than 1/2 inch bolts. Braces shall conform to all applicable codes and standards. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 50 percent of the weight of equipment without exceeding safe working stress of bracing components. Details of all equipment bracing shall be submitted for approval.
 - b. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90 degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are included at a 45 degree angle.

H. Ceiling mounted air terminals or services installed in lay-in ceilings

1. Positively attach to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

I. Miscellaneous Equipment

1. The following specific items of equipment to be furnished under this contract shall be constructed and assembled so as to be capable of withstanding the horizontal equivalent static force of 0.11 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.
 - a. Air Handling Units
 - b. Free Standing Electric Motors

J. Floor Mounted Equipment Support

1. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.
2. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.2 ADJUSTING AND CLEANING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

3.3 SPECIAL INSPECTION

- A. Special Inspector: Employ a factory trained representative during construction to observe the work specified and to ensure that it conforms to the Contract documents. Factory trained representative shall be a qualified person who shall demonstrate competence and specialized experience, to the satisfaction of the engineer of record, for inspection of the seismic protection of mechanical and electrical equipment.
- B. Inspection Requirements: The factory trained representative shall periodically inspect the following systems to verify conformance with the contract documents and the local code:
 1. Installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F.
 2. Installation of HVAC ductwork that will contain hazardous materials in structures assigned to Seismic Design Category C, D, E or F.
 3. Installation of vibration isolation systems in structures assigned to Seismic Design Category C, D, E or F where a nominal clearance of 0.25 inches or less between the equipment support frame and restraint is required.
- C. Inspection Reports: Ensure that the inspection report is furnished from the special inspector to the engineer of record. At the end of the work, ensure that a final, signed report is submitted by the special inspector, stating whether the work requiring special inspection was, to the best of the special inspector's knowledge, in conformance with the Contract documents.
- D. Discrepancies: Discrepancies shall be brought to the immediate attention of the Contractor for correction, and then, if uncorrected, to the architect and engineer of record.

END OF SECTION

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DIVISION 21 - FIRE SUPPRESSION SPECIFICATION

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SECTION 13900 (210010) - GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 21 of the Specifications and Drawings numbered with prefixes <FS> generally describe these systems, but the scope of the Fire Suppression work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general location and arrangement of the equipment, piping, etc. without showing all the exact details as to elevations, offsets, pipe routing, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. This system has been designed by a registered Fire Protection Engineer, licensed in the State of California. Design documents have been submitted to the City of Stockton Fire Marshal's Office and the Owner.
- E. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
 4. Division 21 Section 210533 "Heat Tracing for Fire-Suppression Piping" for heat tracing requirements.
 5. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 6. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 7. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
 8. Division 21 Section 213116 "Diesel-Drive Fire Pumps" "
 9. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
 10. Division 21 Section 213113 "Electric-Drive Fire Pumps" for fire pumps.
 11. Division 21 Section 213220 "Water Storage Tank"

1.2 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.
- G. Regulatory Requirements: Comply with all standards listed in Section 1.2 and all applicable local requirements.
- H. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section, Division 26 and Division 28.
- I. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the submission of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
 1. NFPA (National Fire Protection Association) 13, "Installation of Sprinkler Systems", 2022 Edition.
 2. NFPA 14, "Installation of Standpipes, Private Hydrants and Hose Systems", 2019 Edition.
 3. NFPA 20, "Installation of Stationary Pumps for Fire Protection", 2022 Edition.
 4. NFPA 24, "Private Fire Service Mains and their Appurtenances", 2022 Edition.
 5. NFPA 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems", 2013 Edition With California Amendments.

6. NFPA 22, “Water Tanks for Private Fire Protection”, 2018 Edition
7. Underwriters Laboratories, “Fire Protection Equipment Directory”, Latest Edition.
8. Factory Mutual Systems, “Approval Guide”, Latest Edition.
9. California Fire Code (CFC) 2022 Edition with local amendments.
10. International Building Code (IBC), 2018 Edition with local amendments.
11. International Fire Code (IFC), 2018 Edition with local amendments.

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All Fire Suppression work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Fire Suppression work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. **Furnish:** The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. **Install:** The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. **Provide:** The term “provide” means “to furnish and install, complete and ready for the intended use.” When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. **Engineer:** Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
9. **Value Engineering:** A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- D. Other definitions for fire protection systems are listed in NFPA Standards 13, 14, 20 and 24.
- E. Working Plans, also referred to as Fire Protection Drawings as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the Authority Having Jurisdiction.
- F. The following definitions apply to excavation operations:
 - 1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 - 2. Sub-base: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 - 3. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 - 4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.
- C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Fire Suppression systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect/Engineer. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.
- E. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire protection system shall include, but not be limited to:
 - 1. Sprinkler monitoring equipment (water flow switches, valve tampers, etc) shall be provided by the fire sprinkler installer, but wired and connected by Division 28.
- F. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and described within the specification sections.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
 6. Indicate required installation sequence to minimize conflicts between entities.
 7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
 1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
 2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
 3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
 4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.

- a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
3. Where Henderson Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, Henderson Engineers makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.
- B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- F. Refer to individual Sections for additional submittal requirements.
- G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Fire Suppression construction starts.
- H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- I. Submittals shall contain the following information:
 1. The project name.
 2. The applicable specification section and paragraph.
 3. Equipment identification acronym as used on the drawings.
 4. The submittal date.
 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 6. Submittals not so identified will be returned to the Contractor without action.

- J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.
- L. Provide shop drawings prepared in accordance with referenced standards identified as "Working Plans", including hydraulic calculations where applicable. Shop drawings shall be signed and sealed by a Professional Engineer registered in the state in which the project is located where required by local authorities having jurisdiction, or NICET Level III or IV certified technician. Submit copies of the certification for the designer with submittal. Shop drawings consisting of the following shall be furnished at a minimum. Refer to NFPA 13 for additional requirements.
1. Scaled site plan indicating underground piping with sizes and hydrants utilized for flow test in relation to the building.
 2. Layout drawings of complete fire sprinkler system indicating relationship to all other trades. This shall include all equipment, piping and a reflected ceiling plan indicating sprinkler locations.
 3. Complete details and sections as required to clearly define and clarify the design indicated.
 4. Shop drawings shall be to a standard scale and not less than 3/32" = 1'-0".
 5. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
 6. Hydraulic calculations shall be based on a water flow test conducted at the site within twelve (12) months of the submittal of plans for approval. The contractor shall be responsible for obtaining the flow test if existing data is not available. Flow test information shall be documented on shop drawings with an accompanying site plan to scale. Contractor shall verify with AHJ any minimum safety factor requirements. Demand shall not be less than 10 percent below the supply at the demand point.
 - a. Hydrant testing shall be in accordance with NFPA 13 and 291 requirements.
 7. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 09-01-2021
 - b. Performed by: Chad A. Lueder, PE.
 - c. Static Pressure at Residual Fire Hydrant: 48 psig
 - d. Measured Flow at Flow Fire Hydrant: 3669 gpm
 - e. Residual Pressure at Residual Fire Hydrant: 37 psig
- M. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval. Shop drawings showing deviations from the design without prior approval will not be approved.
- N. Provide welders' qualification certificates.
- O. Provide Test Reports and Certificates including:
1. "Contractor's Material & Test Certificate for Aboveground Piping"
 2. "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA
 - a. Underground piping test certificate shall be obtained prior to connection of the aboveground system.

- P. [BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established Project]

1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.10 SUBSTITUTIONS

- A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion for the project, furnish to the Architect, for Engineer's review, and for Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Include the following sections with the appropriate information for each section:
 - 1. Typewritten Index.
 - 2. Qualifications. Provide designer and installer qualification.
 - 3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
 - 4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
 - 5. Product Data: Provide product cut-sheets for all equipment utilized and installed.
 - 6. Guarantee. Copy of all guarantees and warranties issued.
 - 7. Testing/Certification: Provide all completed testing and certification forms as required per NFPA 13 and 25.
 - 8. Contact list with minimum three service representative phone numbers.
- F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.12 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 21 specifications.

1.13 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

- D. The fire shop drawings and all information contained therein shall be utilized as the basis for the Record Drawings.

1.14 TRAINING

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in a format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.15 PAINTING

- ~~A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Fire Suppression Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.~~
- ~~B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.~~
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.17 GUARANTEES AND WARRANTIES

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Furnish service and maintenance of fire protection system for one year from date of substantial completion.
- C. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- D. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
 2. Proper sloping of pipe to drain in each piping system per NFPA 13.
- E. The above guarantees shall include labor (including travel expenses), troubleshooting and material; and repairs or replacements shall be made without additional cost to the Owner.
- F. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- G. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed and stating the commencement date and term.

1.18 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings:
1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the site prior to submitting their bid to determine the nature and extent of work involved.
 2. Work in the existing building shall be scheduled with the Owner.
 3. Certain demolition work must be performed prior to the remodeling. The Fire Suppression Contractor shall perform the demolition which involves Fire Suppression and Fire Suppression systems, equipment, piping, equipment supports or foundations and materials.
 4. Fire Suppression Contractor shall remove articles which are not required for the new work. Unless otherwise indicated, each item removed by the Fire Suppression Contractor during this demolition shall be removed by the Fire Suppression Contractor from the premises and disposed of in accordance with applicable federal, state and local regulations.
 5. Fire Suppression Contractor shall relocate and reconnect Fire Suppression equipment that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Fire Suppression equipment or materials are removed, the Fire Suppression Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
 6. General Contractor shall install finish material.
 7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
 8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect Fire Suppression services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
 3. Use of explosives is not permitted.
- C. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Electrical Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Fire Suppression Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Fire Suppression Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections.
- C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.
- D. Refer to Division 28, "Fire Detection and Alarm" for specification of sprinkler monitoring equipment connections.
- E. All fire protection equipment shall be UL listed and FM approved (FM Insureds only) for its intended use and in conformance with the applicable NFPA codes.
- F. System Pressures: All system components shall be listed for the actual designed system pressures.
 - 1. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
 - 2. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.

2.2 SOIL MATERIALS

- A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install, and test all new equipment identified in this contract and revise existing equipment as noted.
- B. Installation shall be in accordance with NFPA requirements and the Contractor shall have employed or enlist the design services of at least one minimum NICET Level II certified technician.
- C. Installer: Company specializing in the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire sprinkler submittal proof of factory training for each installer.

- D. The Contractor shall provide all required equipment, sprinklers and piping for a complete and operational fire protection system. All components shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.
- E. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

3.2 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Fire Suppression Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.3 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Section.
- B. Report test results promptly and in writing.

3.4 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish, remove, demount, and disconnect abandoned Fire Suppression materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- B. Materials and equipment to be salvaged: Remove, demount, and disconnect existing Fire Suppression materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- D. Fire Suppression Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings, specialties, equipment and controls.
 - a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 1, General Conditions and "Cutting and Patching" portion of this Section in Division 21.

3.6 EXCAVATION AND BACKFILLING

- A. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.
- B. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- C. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- D. The Contractor shall erect barricades around excavations, for safety, and shall place an adequate number of amber lights on or near the work and shall keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- E. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- F. Install sediment and erosion control measures in accordance with local codes and ordinances.
- G. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- H. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- I. Excavation for Underground Tanks, Basins, and Fire Suppression Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.

2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- J. Trenching: Excavate trenches for Fire Suppression installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
 2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
 - a. For pipes or equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tamped sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- L. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 2. Under building slabs, use drainage fill materials.
 3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
 5. Other areas, use excavated or borrowed materials.
- M. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- N. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- O. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- P. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

- Q. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas under structures, building slabs, steps, and pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas under walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
 2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- R. Subsidence: Where subsidence occurs at Fire Suppression installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.7 CUTTING AND PATCHING

- A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.
- B. No structural member shall be cut without permission from Architect and Structural Engineer.
- C. Patch around openings to match adjacent construction.
- D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.8 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Fire Suppression Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Fire Suppression Contractor shall clean material and equipment installed under the Fire Suppression Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.9 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
 1. Submit complete Operation and Maintenance Manuals.
 2. Submit complete Record Drawings.
 3. Perform special inspections.

4. Start-up testing of systems.
 5. Removal of temporary facilities from the site.
 6. Comply with requirements for Substantial Completion in the "General Conditions".
-
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
 - C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
 - D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
 - E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, they shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
 - F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
 - G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
 - H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
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Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
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Engineer Review and Recommendation Section

Recommend Acceptance Yes No

Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

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SECTION 13905 (210500) - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with Fire Suppression installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to Fire Suppression materials and equipment.
 2. Concrete for bases and housekeeping pads.
 3. Non-shrink grout for equipment installations.
 4. Miscellaneous metals for support of Fire Suppression materials and equipment.
 5. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Fire Suppression materials and equipment.
 6. Joint sealers for sealing around Fire Suppression materials and equipment.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
 2. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
 4. Division 21 Section 210533 "Heat Tracing for Fire-Suppression Piping" for heat tracing requirements.
 5. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 6. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 7. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
 8. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
 9. ~~Division 21 Section 213113 "Electric Drive Fire Pumps" for fire pumps.~~
 10. Division 21 Section 213116 "Diesel-Drive Fire Pumps" for fire pumps,
 11. Division 21 Section 213220 "Water Storage Tank"

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 and Division 21 Section "General Fire Suppression Requirements".
1. Product data for the following products:
 - a. Access panels and doors.
 - b. Through and membrane-penetration firestopping systems.
 2. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 - 1. Provide UL Label on each fire-rated access door.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. [Acceptable]Manufacturer[s]:
 - 1. Bar-Co., Inc.
 - 2. Elmdor Stoneman.
 - 3. JL Industries
 - 4. Jay R. Smith Mfg. Co.
 - 5. Karp Associates, Inc.
 - 6. Milcor
 - 7. Nystrom Building Products
 - 8. Wade
 - 9. Zurn
- B. Access Doors:
 - 1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Fire Suppression Piping and Equipment" for labeling of access doors.
 - 2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
 - 3. Access doors must be of the proper construction for type of construction where installed.
 - 4. The exact location of all access doors shall be verified with the Architect prior to installation.
 - 5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
 - 6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
 - 7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
 - 8. Locking Devices: Flush, screwdriver-operated cam locks.
 - 9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.2 FIRE SUPPRESSION EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated Fire Suppression equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and

power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Fire Suppression equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Pumps and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2"
Pumps 30 HP to 75 HP (See Note 1)	7-1/4"
Pumps greater than 75 HP (See Note 1)	11-1/4"

NOTES:

- 1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.5 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.6 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWP rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
 - 1. Framing materials shall be fire resistant treated for use in Type I and II buildings.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.
 - 1. Framing materials shall be fire resistant treated for use in Type I and II buildings.

2.7 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
 - a. "Dow Corning 790," Dow Corning Corp.
 - b. "Silglaze II SCS 2801," General Electric Co.
 - c. "Silpruf SCS 2000," General Electric Co.
 - d. "864," Pecora Corp.
 - e. "Rhodia 5C," Rhone-Poulenc, Inc.
 - f. "Spectrem 1," Tremco, Inc.
 - g. "Spectrem 2," Tremco, Inc.
 - h. "Dow Corning 795," Dow Corning Corp.
 - i. "Rhodia 7B," Rhone-Poulenc, Inc.
 - j. "Rhodia 7S," Rhone-Poulenc, Inc.
 - k. "Omniseal," Sonneborn Building Products Div.
 - 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
 - a. "Dow Corning 786," Dow Corning Corp.
 - b. "Sanitary 1700," General Electric Co.
 - c. "898 Silicone Sanitary Sealant," Pecora Corp.
 - d. "OmniPlus," Sonneborn Building Products Div.

- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremflex 834," Tremco, Inc.

2.8 ACOUSTICAL SEALANTS

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m³).

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.3 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Fire Suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.4 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.5 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.6 PENETRATIONS:

- A. New Construction:
 - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping penetrations.
- B. Construction in Existing Facilities:
 - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

- J. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 21 Section “Basic Fire Suppression Piping Materials and Methods

END OF SECTION

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SECTION 13907 (210515) - BASIC FIRE SUPPRESSION PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 21 and includes piping, joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 3. Division 21 Section 210533 "Heat Tracing for Fire-Suppression Piping" for heat tracing requirements.
 4. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 5. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 6. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
 7. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.
 - ~~8. Division 21 Section 213113 "Electric Drive Fire Pumps" for fire pumps.~~
 9. Division 21 Section 213116 "Diesel-Drive Fire Pumps" for fire pumps.
 10. Division 21 Section 213220 "Water Storage Tank"

1.2 SUBMITTALS

- A. Refer to Division 1 and Division 21 "General Fire Suppression Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
1. Piping and Fittings
 2. Escutcheons
 3. Dielectric Unions and Fittings
 4. Sleeves and Mechanical Sleeve Seals
 5. Wall Pipes

1.3 QUALITY ASSURANCE

- A. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.
- B. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- C. Threaded joints shall conform to ASME B1.20.1, Pipe Threads, General Purpose and the Pipe Fitters Handbook.

D. UL and FM Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, and Factory Mutual approved (FM Insureds only) for fire service.

~~E. Pipe, piping specialties and fittings shall be manufactured in plants located in the United States.~~

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL REQUIREMENTS

- A. All fire suppression system materials and components essential to successful system operation shall be listed for their intended purpose.
- B. For FM Global insured projects – All fire Suppression system materials and components shall be U.L. and FM approved.
- C. General: Refer to the individual piping system specification sections in Division 21 for specifications on piping and fittings relative to that particular system.

2.2 STEEL PIPE AND FITTINGS

- A. All piping 2-inch and smaller:
 - 1. With the use of welded or roll grooved fittings: ASTM A135 or 795, Grade A, Schedule 10 or 40, seamless or ERW, black steel pipe.
 - 2. With the use of threaded fittings: ASTM A135 or 795, Grade A, Schedule 40, seamless or ERW, black steel pipe. All 1-inch piping shall have threaded ends.
- B. All piping 2-1/2" and larger: ASTM A135 or 795, Grade A, Schedule 10, ERW, black steel pipe, roll grooved ends.
- C. Piping used in dry pipe sprinkler systems shall be ASTM A135 or 795, Type E, Grade A, Schedule 40, Black Steel pipe, threaded or roll grooved ends.
- D. All piping on the exterior of the building shall be externally galvanized.
- E. Acceptable alternatives to Schedule 40 and Schedule 10 pipe shall be manufactured to standards recognized by NFPA 13. Threaded pipe shall have a corrosion resistance rating (CRR) of 1.0 or greater. Crimp type couplings shall not be used. Threadable thinwall pipe with CRR less than 1.0 not permitted.
- F. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- G. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- H. Steel Couplings: ASTM A 865, threaded
- I. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- J. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- K. Malleable- or Ductile-Iron Unions: UL 860. Not allowed.
- L. Cast-Iron Flanges: ASME 16.1, Class 125.

- M. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- N. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- O. Grooved-Joint, Steel-Pipe Appurtenances
 - 1. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
 - 3. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

~~2.3 COPPER TUBE AND FITTINGS~~

- ~~A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.~~
- ~~B. Cast Copper, Solder Joint Fittings: ASME B16.18, pressure fittings.~~
- ~~C. Wrought Copper, Solder Joint Fittings: ASME B16.22, pressure fittings.~~
- ~~D. Bronze Flanges: ASME B16.24, Class 150, with solder joint ends.~~
- ~~E. Copper Unions: MSS SP 123, cast copper alloy, hexagonal stock body, with ball and socket, metal to metal seating surfaces, and solder joint or threaded ends.~~

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
 - 3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.
- B. Check Valves:
 - 1. Description: Swing-check type, rubber-face checks unless otherwise indicated, and ends matching piping.
 - 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Type: Swing check.

5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Description: Bronze body and bonnet and bronze stem.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded or grooved.

D. Iron OS&Y Gate Valves:

1. Description: Iron body and bonnet and bronze seating material.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded or grooved.
4. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged or grooved.
5. Valve Operation: Integral, prewired supervisory switch and visual indicating device.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing (FM insureds only).
2. Pressure Rating: 175 psig minimum.

B. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.7 AUTOMATIC AIR RELEASE VALVE

A. Standard: UL 2573

B. Pressure Rating: 175 psig minimum.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Standard: UL 405.

2. Type: Exposed, projecting, for wall mounting.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Corrosion-resistant metal.
5. Inlets: NPS 2-1/2 brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
6. Caps: Brass, lugged type, with gasket and chain.
7. Escutcheon Plate: Round, brass, wall type.
8. Outlet: Back, with pipe threads, NPS 4"
9. Number of Inlets: Two.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR
Finish: Rough Brass

B. Storz-Type, Fire-Department Connection:

1. Pressure Rating: 175 psig minimum.
2. Body Material: Aluminum Alloy.
3. Inlets: NPS 6. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
4. Caps: Aluminum with gasket and chain.
5. Escutcheon Plate: Rectangular, brass, wall type.
6. Outlet: NPS 6
7. Escutcheon Plate Marking: Similar to "AUTO SPKR."
8. Include 30 degree downturn elbow.
9. Finish: Anodized aluminum

2.9 PIPING SPECIALTIES

- A. Escutcheons: Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
1. One-Piece, Cast-Brass Type: With rough-brass finish and setscrew fastener.
 2. One-Piece, Stamped-Steel Type: With white painted finish and spring-clip fasteners.
 3. Split-Casting Brass Type: With rough-brass finish and with concealed hinge and setscrew.
 4. Split-Plate, Stamped-Steel Type: With white painted finish, concealed hinge, and spring-clip fasteners.
- B. Floor Plates: Inside diameter shall closely fit pipe outside diameter. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
1. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
 2. Split-Casting Floor Plates: Cast brass with concealed hinge.
- C. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- D. Dielectric Unions and Fittings: Provide factory-fabricated dielectric unions and fittings with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- E. Pressure Gauges
1. Standard: UL 393.
 2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
 3. Pressure Gage Range: 0 to 300 psig.
 4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
 5. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

2.10 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
3. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
4. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

B. Wall Pipes

1. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.

C. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - a. Pressure Plates: Carbon steel or stainless steel.
 - b. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.2 PIPING INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Coordinate installation of horizontal piping with other components. Allow sufficient space above removable ceiling panels to allow for panel removal (minimum 6" clearance).

- C. Install system such that all piping is rigidly secured and supported. Cutting of structural members for passage of sprinkler pipes or hangers shall not be permitted. Coordination between ductwork, lights, structural members and sprinkler pipe to be coordinated on the construction phase of the project.
- D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise. In areas with ceilings, piping shall be routed concealed, above ceiling. In areas without ceilings, piping shall extend as high as possible.
- E. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- F. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- I. Install sprinkler piping to provide for system drainage in accordance with NFPA 13. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.
- J. Coordinate pipe routing near electrical equipment in accordance with NFPA 70.
- K. Verify final equipment locations for roughing in.
- L. Deviations from approved "Working Plans" for sprinkler piping require written approval of the Authority Having Jurisdiction. Written approval shall be on file with the Engineer prior to deviating from the approved "Working Plans."
- M. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions in pipes NPS 2 and smaller, adjacent to each valve. Unions are not required on flanged devices or in piping installations using grooved mechanical couplings.
- D. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.
- F. Non-ferrous Pipe Joints:
 - 1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping.

2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- G. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - a. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
 - H. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads and Pipe Fitter's Handbook. Join pipe, fittings, and valves as follows:
 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads.
 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
 5. Damaged Threads: Do not use pipe with threads that are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
 - I. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9. Align flanged surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
 - J. Mechanical Grooved Joints: Roll grooves on pipe ends dimensionally compatible with the couplings. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
 - K. Joints for other piping materials are specified within the respective piping system sections.

3.4 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire department connection.
- B. Install connections between 18- and 36-inches above finished grade and as indicated on the Drawings.
- C. Grout or caulk pipe penetration in exterior wall.
- D. Provide minimum 36-inch working clearance around connection for fire department access.
- E. Install automatic (ball drip) drain valve at each check valve for fire department connection. The drain line shall discharge to the exterior.
- F. Install two protective pipe bollards on sides of each fire department connection. Comply with requirements for bollards in Division 5 Section 055000 "Metal Fabrications."

3.5 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision.
- B. Supervisory Switches: Supervise valves in open position unless noted otherwise.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
1. Valves: Install chain and padlock on open OS&Y gate valve.
 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Water-Flow Indicators: Install in fire suppression piping where indicated. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- E. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.6 PIPING PROTECTION

- A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at the end of each day or whenever work stops.

3.7 PENETRATIONS

- A. Fire suppression penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Above Grade Concrete or Masonry Penetrations
 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
 - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
 - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
 2. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- C. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
 1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 2. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

- D. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
 2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
 4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
 5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- F. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
 2. Provide 1/2-inch thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2-inch above and below the concrete slab.
- G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of sealant. Refer to Division 21 Section "Common Work Results for Fire Suppression" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.
- H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2-inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1-inch annular clear space between inside of sleeve and outside of insulation.
- I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 21 Section "Common Work Results for Fire Suppression" for firestopping and materials.

3.8 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the Fire Suppression equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.
- B. Fire Sprinkler Piping
1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than

the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

3.9 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.

END OF SECTION

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SECTION 13917 (210548) - SEISMIC CONTROLS FOR FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 20 Section "Seismic Controls for MEP/F/T Systems" for general requirement and related documents that apply to this section.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: International Code Council Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 SUMMARY

- A. Seismic bracing, restraints, and controls for all fire protection systems specified herein shall be designed and installed as required by Division 20 Section "Seismic Controls for MEP/F/T Systems".

1.5 SUBMITTALS

- A. Provide submittals as required by Division 20 Section "Seismic Controls for MEP/F/T Systems" for all fire protection systems specified herein.

PART 2 - PRODUCTS AND MATERIALS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes heat tracing with the following electric heating cables:
 - 1. Self-regulating, parallel resistance.
- B. Related Sections include the following:
 - 1. Division 22 Section "Heat Tracing for Plumbing Piping."

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

- A. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BH Thermal Corporation.
 - 2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
 - 3. Delta-Therm Corporation.
 - 4. Easy Heat Inc.
 - 5. Nelson Heat Trace.
 - 6. Pyrotenax; a division of Tyco Thermal Controls.
 - 7. Raychem; a division of Tyco Thermal Controls.
 - 8. Thermon Manufacturing Co.
 - 9. Trasor Corp.
- B. Heating Element: Pair of parallel No. 16 or 18 AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F. Verify temperature of circulated media in freeze-protected piping in first paragraph below.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Maximum Operating Temperature: 300 deg F.

2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 4 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to manufacturers guidelines, NFPA 13, and FM Data Sheets.
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 13911 (210553) - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of Fire Suppression work to be identified as required by this Section is indicated on drawings and/or specified in other Division 21 Sections.
- B. Types of identification devices specified in this Section include the following:
 - 1. Equipment labels.
 - 2. Valve tags.
 - 3. Hydraulic placards.
 - 4. Pipe labels.
 - 5. Stencils.
- C. Related Sections
 - 1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
 - 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 - 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
 - 4. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 - 5. Division 21 Section 211100 "Fire Suppression Water Service Piping," for fire suppression piping starting 5 feet outside the building to within the building.
 - 6. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire-suppression sprinkler systems inside the building.
 - 7. Division 21 Section 213113 "Electric-Drive Fire Pumps" for fire pumps.
 - 8. Division 21 Section 213116 "Diesel-Drive Fire Pumps" for fire pumps.

1.2 CODES AND STANDARDS:

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, aluminum, or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
 - 2. Background/Letter Color: Red/White or Bare Metal/Black.
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Background/Letter Color: Red/White
3. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number,

2.2 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
1. Tag Material: Brass, stainless steel, aluminum or anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
 2. Fasteners: Brass wire-link chain, beaded chain or S-hook.
 3. Valve-Tag Color: Red.
 4. Letter Color: White.

2.3 HYDRAULIC PLACARDS

- A. Provide hydraulic calculation placard attached to each riser in accordance with NFPA 13. Placard shall include location of design area or areas, discharge densities over the design area or areas, required flow and pressures at the base of riser, occupancy classification and maximum permitted storage height and configuration, hose stream allowance included in addition to the sprinkler demand and name of installing contractor. Information shall be permanently and clearly displayed on placard.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- B. Pretensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
- E. Lettering Size: At least 1-1/2 inches high.
- F. Pipe-Label Colors:
1. Background Color: Red.
 2. Letter Color: White.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel, black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT IDENTIFICATION

- A. General: Install metal or plastic equipment marker on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Pumps
2. Tanks and pressure vessels
3. Backflow Preventers

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire suppression systems

3.4 LABEL INSTALLATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each major piece of equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection excluding short takeoffs. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 3. At access doors, manholes, and similar access points that permit view of concealed piping.
 4. Near major equipment items and other points of origination and termination.
 5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

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SECTION 13925 (211100) - FIRE SUPPRESSION WATER SERVICE PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. The extent of this fire suppression water service piping shall be as specified herein. Contractor shall be responsible for preparation of design drawings, fabrication and installation for complete fire suppression water service piping for the building.
- B. This section specifies:
 - 1. Materials and equipment for fire suppression water service piping and related components starting 5-feet outside the building and the following:
 - a. Service entrance piping through floor into the building.
 - b. Service entrance piping through wall into the building.
- C. This section includes:
 - 1. Pipe and fittings
 - 2. Valves
 - 3. Post indicating valves
 - 4. Backflow preventers
 - 5. Fire department connection
 - 6. Alarm devices
 - 7. Accessories
- D. Provide facility fire suppression water service piping during construction in accordance with code.
- E. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 21 Specifications Sections, apply to this section.
- F. Related Sections:
 - 1. Division 31 Section "Earthwork," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 33 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building and extending to the water service line.
 - 3. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, fire flow test data, obtaining electronic drawings files, shop drawings and record drawings.
 - 4. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 - 5. Division 21 Section 210533 "Heat Tracing for Fire-Suppression Piping" for heat tracing requirements.
 - 6. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 - 7. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 - 8. Division 21 Section 211313 "Water-based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.
 - 9. Division 21 Section 213113 "Electric-Drive Fire Pumps" for fire pumps.
 - 10. Division 21 Section 213116 "Diesel-Drive Fire Pumps" for fire pumps.
 - 11. Division 21 Section 213220 "Water Storage Tank

1.2 SUBMITTALS

- A. Submit shop drawings prepared in accordance with Division 21 Section 210010 “General Fire Suppression Requirements.”
- B. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.3 QUALITY ASSURANCE

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of the Facility Fire Suppression Water Service Piping.
- B. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for fire suppression water service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. NFPA 24, “Private Fire Service Mains and their Appurtenances”, Latest Edition. Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire suppression water service piping.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Fire Suppression Water Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general piping fittings and piping specialty requirements.

2.2 DUCTILE-IRON PIPE AND FITTINGS.

- A. Mechanical-Joint, Cement Lined Ductile-Iron Pipe: AWWA C151/C104, with mechanical-joint bell and plain spigot end.
- B. Mechanical-Joint, Cement Lined Ductile-Iron Fittings: AWWA C110/C104, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Flanges: ASME B16.1, Class 125, cast iron.
- D. Ductile-Iron Deflection Fittings:
 - 1. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 2. Pressure Rating: 250 psig minimum.

2.3 SERVICE ENTRANCE ASSEMBLY

- A. At Contractor's option, the service entrance is permitted to utilize a one-piece riser assembly to enter the building.
 - 1. Assembly shall be Ames Fire and Waterworks Series IBR or approved equivalent. In-Building Riser shall be composed of a single extended 90 degrees fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a grooved-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. The grooved end shall include a coupler and cap to facilitate testing of the underground piping.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) or High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or tube.

2.5 CURB VALVES

- A. Curb Valves: Comply with AWWA C800 for high pressure service line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.
- B. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- C. Meter Valves: Comply with AWWA C800 for high pressure service line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

2.6 GATE VALVES

- A. UL Listed or FM Approved Gate Valves:
 - 1. UL listed or FM approved, Iron, Non-rising Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 listing and "Approval Guide," published by FM Global, approval.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.
 - 2. UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 listing and "Approval Guide," published by FM Global, approval.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Flanged or grooved.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5-inches (125 mm) in diameter.
 - 1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- B. Indicator Posts:
 - 1. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
 - 2. Standards: UL 789 listing and "Approval Guide," published by FM Global, approval.

2.8 CHECK VALVES

- A. UL listed or FM approved Check Valves:
 - 1. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
 - 2. Standards: UL 312 listing and "Approval Guide," published by FM Global, approval.
 - 3. Pressure Rating: 175 psig minimum.

2.9 DETECTOR CHECK VALVES

- A. Description: Galvanized cast-iron body, bolted cover with air bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - 1. Standards: UL 312 listing and "Approval Guide," published by FM Global, approval.
 - 2. Pressure Rating: 175 psig minimum.
- B. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.10 PRESSURE-REDUCING VALVES

- A. Water Control Valves:
 - 1. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
 - 2. Pressure Rating: Initial pressure of 150 psig minimum.
 - 3. Main Valve Body: Cast or ductile iron with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Size: 10"
 - b. Pattern: Globe valve design.
 - c. Trim: Stainless steel.
 - 4. Design Flow Rate: 2500 gpm.
 - 5. Design Inlet Pressure: 230 psig.
 - 6. Design Outlet Pressure Setting: 175 psig.
 - 7. End Connections: flanged.

2.11 BACKFLOW PREVENTERS

- A. Double Check Backflow Preventer Assembly:
 - 1. Standard: ASSE 1015.
 - 2. Operation: Continuous-pressure applications unless otherwise indicated.
 - 3. Body Material: Cast iron with fused epoxy coating or stainless steel.
 - 4. End Connections: Threaded, flanged or grooved.
 - 5. Accessories: Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.
- B. Double Check Detector Backflow Preventer Assembly:
 - 1. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
 - 2. Operation: Continuous-pressure applications.
 - 3. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved; Steel with interior lining complying with AWWA C550 or that is FDA approved; or Stainless steel.
 - 4. End Connections: Threaded, flanged or grooved.
 - 5. Accessories:
 - a. Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

- C. Reduced Pressure Zone (RPZ) Backflow Preventer Assembly:
 - 1. Standard: ASSE 1013 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
 - 2. Operation: Continuous-pressure applications.
 - 3. Body Material: Cast iron with fused epoxy coating or stainless steel.
 - 4. End Connections: Threaded, flanged or grooved.
 - 5. Accessories:
 - a. Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

- D. Reduced Pressure Zone (RPZ) Detector Backflow Preventer Assembly:
 - 1. Standards: ASSE 1047 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
 - 2. Operation: Continuous-pressure applications.
 - 3. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved; Steel with interior lining complying with AWWA C550 or that is FDA approved; or Stainless steel.
 - 4. End Connections: Threaded, flanged or grooved.
 - 5. Accessories:
 - a. Supervised butterfly or OS&Y gate valves. Backflow preventer and valves shall be listed as an assembly.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.12 CONCRETE VAULTS

- A. Description: Precast, reinforced concrete vault, designed for A-16 load designation according to ASTM C 857, and made according to ASTM C 858.
- B. Ladder: ASTM A 36/A 36M, steel ladder; or PE-encased steel steps.
- C. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - 1. Dimension: 24-inch (610-mm) minimum diameter unless otherwise indicated.
- D. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.13 FIRE DEPARTMENT CONNECTION

- A. Description: Freestanding, Storz-type with aluminum body, threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose connection inlet; 18-inch high brass sleeve; and round escutcheon plate.
 - 1. Standard: UL 405.
 - 2. Pressure Rating: 175 psig (minimum).
 - 3. Body Material: Corrosion-resistant metal
 - 4. Finish: Rough brass
 - 5. Caps: Powder coated red, lugged type, with gasket and chain.
 - 6. Outlet: 30° elbow.
 - 7. Size: NPS 6
 - 8. Check valve: Sized per NFPA 13 with 3/4" ball drip drain piped to the exterior of the building.

9. Escutcheon Plate Marking: "AUTO SPKR" as applicable."

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated elevation.
- C. Pipe Beds:
1. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. Provide first layer of pea gravel backfill 6-inch above pipe, tamp backfill with mechanical tamper to 85% to 95% compaction. For piping with rock trench bottoms, provide sand pipe bed 6-inch underneath and around sides of pipe up to middle half of the pipe, including fittings.
- D. Provide backfill above top of pipe bed as required for field conditions. Refer to Division 21 Section 210010 "General Fire Suppression Requirements" for materials and methods for backfill.

3.3 PIPE APPLICATIONS

- A. Piping below grade: Provide cement lined ductile iron pipe and fittings with mechanical joints.

3.4 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire service main piping materials and installation.
- B. Water main connection: Arrange with water utility company for tap of size and in location indicated in water main or tap water main according to the requirements of the water utility company.
- C. Install ductile-iron, water service piping according to AWWA C600 and AWWA M41.
1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- D. Bury piping with depth of cover over top of piping at least 30-inches, with top at least 12-inches below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least 36-inches of cover over top.
 2. Under Railroad Tracks: With at least 48-inches of cover over top.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. Extend fire suppression water service piping and connect to water supply source and building fire suppression water service piping systems at locations and pipe sizes indicated.

1. Terminate fire suppression water service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire suppression water service piping systems when those systems are installed.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
 - H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."
 - I. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210515 "Basic Fire Suppression Piping Materials and Methods."
 - J. Make connections between underground and aboveground piping using an approved transition piece strapped or fastened to prevent separation.
- 3.5 JOINT CONSTRUCTION
- A. See Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general joint construction requirements.
 - B. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
 - C. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
 - D. Ductile-Iron Piping, Gasketed-Joints for Fire Service Main Piping: UL 194.
 - E. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- 3.6 ANCHORAGE INSTALLATION
- A. Anchorage, General: Install water distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Locking mechanical joints.
 2. Bolted flanged joints.
 - B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire suppression water service piping according to NFPA 24 and the following:
 1. Gasketed-Joint, Ductile-Iron, Water Service Piping: According to AWWA C600.
 - C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.
- 3.7 VALVE INSTALLATION
- A. See Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general valve installation requirements.
 - B. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve(s) in vaults with stem pointing up, and with vertical cast-iron indicator post.

- C. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- D. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.
- E. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03.

3.8 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions

3.9 BACKFLOW PREVENTER INSTALLATIONS

- A. Install backflow preventer at each fire protection entry in compliance with the plumbing code and Authority Having Jurisdiction. Locate in an accessible and testable location.
 - 1. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain or exterior.
- B. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks.
- C. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- D. Do not install bypass piping around backflow preventers.
- E. Support NPS 2-1/2 and larger backflow preventers with pipe supports attached to the floor with anchor bolts where indicated on the drawings.
- F. Test backflow preventer per requirements of plumbing or division of cross connection control official.
 - 1. Reports: Prepare backflow preventer test reports signed by the plumbing or division of cross connection control official and turn over to the Architect upon completion of the project.

3.10 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.11 POST INDICATOR VALVE

- A. Install post indicator valve on the underground supply, as indicated on the Drawings. Post indicator valve shall be electronically supervised-open.

3.12 FIRE DEPARTMENT CONNECTION INSTALLATIONS

- A. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and discharge to outside building.
- B. Install connections between 18- and 36-inches above finished grade and as indicated on the Drawings.
- C. Install mechanical sleeve seal at pipe penetration in outside walls.
- D. Provide minimum 36-inch working clearance around connection for fire department access.

- E. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.13 FIELD QUALITY CONTROL

- A. Flush, test, and inspect in accordance with NFPA 24.
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
- C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

3.14 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground fire suppression water service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.15 CLEANING

- A. Clean fire suppression water service piping as follows:
 - 1. Flush new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use flushing procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
- B. Prepare reports of flushing activities.

END OF SECTION

SECTION 13930 (211313) - WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. The extent of this fire sprinkler system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication and installation for complete fire sprinkler protection for the building.
- B. Section Includes:
1. Pipes, fittings, and specialties.
 2. Fire protection valves.
 3. Sprinkler pipe fittings.
 4. Sprinklers.
 5. Alarm devices.
 6. Control panels.
- C. Related Sections:
1. Division 21 Section 210010 "General Fire Suppression Requirements" for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
 2. Division 21 Section 210500 "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 3. Division 21 Section 210515 "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
 4. Division 21 Section 210533 "Heat Tracing for Fire-Suppression Piping" for heat tracing requirements.
 5. Division 21 Section 210548 "Seismic Controls for Fire Protection" for seismic bracing requirements.
 6. Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 7. Division 21 Section 211100 "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
 8. Division 21 Section 211200 "Fire Suppression Standpipes" for fire-suppression standpipes inside the building.
 9. ~~Division 21 Section 213113 "Electric Drive Fire Pumps" for fire pumps.~~
 10. Division 21 Section 213116 "Diesel-Drive Fire Pumps" for fire pumps.
 11. Division 21 Section 213220 "Water Storage Tank"

1.2 SYSTEM DESCRIPTION

- A. Fire protection system in the location or portion of the building is a combination of Wet Pipe, and Dry Pipe Systems.
1. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to a water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts a fusible link or destroys a frangible device. Hose connections are included if indicated.
 2. Dry Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open a dry pipe valve. Water then flows into piping and discharges from sprinklers that are open.

- B. Provide system(s) as specified herein and as shown on drawings. The sprinkler system shall be supplied by the underground as shown on the Drawings.
- C. Provide dry pipe fire protection system for non-heated spaces and other areas of building subject to freezing including the loading docks and canopies, mansards, and balconies. Portions of systems subject to freezing or temperatures below 40° F shall be protected against freezing as required by NFPA 13. The Contractor shall be responsible for repairs and for all costs incurred from damage caused by freezing of the fire protection system.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design fire suppression system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Standard Pressure, Fire Suppression System Component: Listed for 175-psig minimum working pressure.
- C. High Pressure, Fire Suppression System Component: Listed for 250-psig minimum working pressure.
- D. Performance Criteria
 - 1. Protect Low bay area: with a sprinkler system designed in accordance with FM Data Sheets 8-9 Storage of Class 1,2,3,4 and plastics, Table 17B, 10 Sprinklers K25 ESFR @ 50 PSI.
 - 2. Protect High bay area over KNAPP Racks FM Data Sheets 8-34, Protection of Automated Storage and Retrieval Systems. Table 19. . Design criteria will depend on the elevation of storage above top level and vertical distance between top level and ceiling (K25 ESFR sprinklers)
 - 3. KNAPP racks per UL testing K25 sprinklers, 8 sprinklers (4 sprinkler on 2 adjacent lines) @ 35 PSI. 4 Sprinklers (2 sprinklers on 2 adjacent lines) @ 50 PSI.
 - 4. Protect Roof deck over Platform area with a sprinkler system designed in accordance to FM Data Sheets 8-9 Storage of Class 1,2,3,4 and plastics, Table 8, 9 Sprinklers K25 ESFR @ 20 PSI
 - 5. Protect Material Handling Equipment in building, unless noted otherwise, with a sprinkler system designed in accordance with FM Data Sheets 8-34, Protection of Automated Storage and Retrieval Systems.
 - 6. Protect Mezzanine area of work, unless noted otherwise, with a sprinkler system designed in accordance with FM Data Sheets 3-26 Fire Protection for Non-storage occupancies. 0.30gpm/2500sq.ft. for ceilings 30'-0" in height. 30'-0" to 45'-0" utilize sprinkler design .0.30gpm/3600sq.ft.
 - 7. Protect mechanical and electrical areas/rooms with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 1 requirements.
 - 8. Protect storage areas/rooms, unless noted otherwise, with a sprinkler system designed in accordance with NFPA 13 for Ordinary Hazard Group 2 requirement.
 - 9. Other Occupancy Hazard Classifications.
 - a. Building Service Areas: Ordinary Hazard Group 1.
 - b. Automobile Parking Areas: Ordinary Hazard, Group 1.
 - c. Machine Shops: Ordinary Hazard, Group 2.
 - d. Office and Public Areas: Light Hazard.
 - 10. Design Criteria for Automatic-Sprinkler Piping Design:
 - a. Light Hazard Occupancy:
 - 1) Minimum Design Density: 0.10 gpm over 1,500 sq.ft. area.
 - 2) Maximum protection area per sprinkler: 225 sq.ft.
 - 3) Minimum Combined Hose Stream Demand Requirement: 100 gpm for 30 minutes.
 - b. Ordinary Hazard Group 1 Occupancy:
 - 1) Minimum Design Density: 0.15 gpm over 1,500 sq.ft. area.
 - 2) Maximum area per sprinkler: 130 sq.ft..
 - 3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
 - c. Ordinary Hazard Group 2 Occupancy:
 - 1) Minimum Design Density: 0.20 gpm over 1,500 sq.ft. area.

- 2) Maximum protection area per sprinkler: 130 sq.ft.
 - 3) Minimum Combined Hose Stream Demand: 250 gpm for 60 to 90 minutes.
 - d. Extra Hazard Group 1 Occupancy:
 - 1) Minimum Design Density: 0.30 gpm over 2,500-sq.ft. area.
 - 2) Maximum protection area per sprinkler: 100 sq.ft.
 - 3) Minimum Combined Hose Stream Demand: 500 gpm for 90 to 120 minutes.
 - e. Extra Hazard Group 2 Occupancy:
 - 1) Minimum Design Density: 0.40 gpm over 2,500-sq.ft. area.
 - 2) Maximum protection area per sprinkler: 100 sq.ft.
 - 3) Minimum Combined Hose Stream Demand: 500 gpm for 90 to 120 minutes.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 - g. Other:
 - 1) Maximum protection area per sprinkler: 100 sq.ft.
 - 2) Minimum Combined Hose Stream Demand: 500 gpm for 120 minutes.
- E. The criteria listed herein shall not preclude the use of extended coverage or special application fire sprinklers designed and installed in accordance with their listing and manufacturer's instructions.
- F. The hydraulic area of operation may not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers in unfinished shell spaces. For all other areas, the hydraulic area of operation shall not be reduced as allowed by NFPA 13 for areas utilizing quick response sprinklers unless specifically approved by the Engineer via a formally submitted RFI.
- G. Sprinkler spacing shall conform to NFPA 13 and shall not exceed 225 SF per sprinkler in unfinished shell spaces.
- H. The hydraulic area of operation shall be increased by 30% without revising the density for areas with sloped ceilings with a pitch exceeding 1 in 6 (16.7% slope) in accordance with NFPA 13.
- I. The hydraulic area of operation shall be increased by 30% without revising the density for dry-pipe systems in accordance with NFPA 13.

1.4 SUBMITTALS

- A. Submit shop drawings prepared in accordance with NFPA 13 as specified in Division 21 Section 210010 "General Fire Suppression Requirements."

1.5 QUALITY ASSURANCE

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire sprinkler system.
- B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Fire Sprinkler Protection: Do not interrupt fire sprinkler system protection to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire sprinkler protection according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of fire-sprinkler protection.
 - 2. Do not proceed with interruption of fire sprinkler protection without Owner's written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Sprinkler Wrenches: Furnish to Owner, 2 sprinkler wrenches for each type of sprinkler installed.
- B. Sprinklers: Furnish extra sprinklers of each style, type and finish included in the project as required by NFPA 13.
- C. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet(s), suitable for wall mounting, with hinged cover and space for the quantity of spare sprinklers provided plus sprinkler wrench(es).
- D. Provide hydraulic calculation placard attached to each riser.

PART 2 - PRODUCTS AND MATERIALS

2.1 EQUIPMENT

- A. All fire protection equipment shall be UL listed and FM approved for its intended use and in conformance with the applicable NFPA documents.

2.2 PIPE AND FITTING MATERIALS

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on piping and fittings.

2.3 HANGERS

- A. Shall be UL listed and shall meet requirements of NFPA 13 for type, dimension and location.

2.4 GENERAL DUTY VALVES

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for specifications on general duty valves.

2.5 SPECIALTY VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by Factory Mutual, approval.
 - 2. Pressure Rating:
 - a. Standard Pressure Piping Specialty Valves: 175-psig minimum.
 - b. High Pressure Piping Specialty Valves: 250-psig minimum.
 - 3. Body Material: Cast- or ductile- iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Alarm Valves:
 - 1. Standard: UL 193.
 - 2. Design: For horizontal or vertical installation.

3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Dry-Pipe Valves:

1. Standard: UL 260.
2. Design: Differential-pressure type.
3. Include UL 1486, quick-opening devices, trim sets for bypass, air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, drip cup assembly piped with check valve to main drain piping, priming chamber attachment, and fill-line attachment with strainer.
4. Air-Pressure Maintenance Device:
 - a. Type: Automatic device to maintain minimum air pressure in piping.
 - b. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
5. Air Compressor:
 - a. Type: Oil-less, air-cooled
 - b. Standard: UL's "Fire Protection Equipment Directory" listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase, hard wired per NEC and manufacturer's requirements.
 - e. Provide combination fused disconnect switch and magnetic starter.

D. Air Release Valve:

1. Provide for all wet pipe sprinkler systems utilizing metallic piping in accordance with one of the following options:
 - a. Manual ball valve with a minimum size of ½ inch (15 mm).
 - b. Listed and/or Factory Mutual Approved automatic valve.

2.6 PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, welded or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Grooved or threaded.

C. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
2. Pressure Rating: 175-psig minimum.

3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

D. Flexible Piping Systems:

1. At Contractor's option, UL listed and FM approved flexible piping connections to sprinklers may be used for both acoustical panel and gypsum board ceilings when suitable for their intended use. Piping shall be seismically qualified per ICC-ES AC-156 where required.
2. Description: Connections shall include a leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1 inch.
3. Flexible piping lengths shall not exceed 6 feet.
4. Installation shall not exceed the minimum bend radius and maximum allowable bends as specified by the manufacturer.
5. Change in direction shall be gradual enough to allow flexible piping to bend without crimping, distorting or reducing internal diameter.

2.7 AUTOMATIC SPRINKLERS

- A. Sprinklers: type and style as indicated or required by application. Sprinkler operating temperatures to comply with NFPA 13. Sprinklers in Light Hazard areas shall be quick response type.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, approval.
 2. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
 3. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767. Tyco Preferred Manufacturer SIN TY9226.
 2. Nonresidential Applications: UL 199.
 3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Use sprinkler types below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Recessed sprinklers as indicated on drawings.
 3. Rooms with Gypsum Board Ceilings: Recessed sprinklers as indicated on drawings>.
 4. Wall Mounting: Sidewall sprinklers.
 5. Spaces Subject to Freezing: Dry pendent or dry sidewall sprinklers as indicated on drawings.
- E. Provide sprinkler types below with finishes indicated.
1. Finished Areas:
 - a. Recessed Sprinklers: SIN TY223 white painted with white escutcheon
 - b. Upright Sprinklers: SIN TY313 Brass
- F. Coordinate sprinkler temperature ratings near heat-producing sources in accordance with NFPA 13.
- G. Sprinklers shall be wax coated where exposed to acids, chemicals, or other corrosive fumes.
- H. Sprinkler Guards: Provide sprinkler guard where sprinklers are less than 7-feet above finished floor; where subject to physical damage, and/or where indicated on drawings. Guard shall be UL 199 listed, wire cage type with fastening device for attaching to sprinkler.

- I. Sprinkler Cabinet and Wrench: Provide a finished steel cabinet, suitable for wall mounting, with hinged cover and space for the appropriate quantity of spare sprinklers plus sprinkler wrench(es).

2.8 ALARM DEVICES

- A. General: Alarm device types shall match piping and equipment connections.
- B. Water Motor Operated Alarm:
 - 1. Standard: UL 753.
 - 2. Type: Mechanically operated, with Pelton wheel.
 - 3. Alarm Gong: Cast aluminum with red-enamel factory finish.
 - 4. Size: 10-inch diameter.
 - 5. Components: Shaft length, bearings, and sleeve to suit wall construction.
 - 6. Inlet: NPS 3/4.
 - 7. Outlet: NPS 1 drain connection.
 - 8. Provide engraved lamacoid plate under Bell lettered "Building Fire Sprinkler System."
- C. Electrically Operated Alarm Bell:
 - 1. Standard: UL 464.
 - 2. Type: Vibrating, metal alarm bell.
 - 3. Size: 6-inch minimum diameter.
 - 4. Finish: Red-enamel factory finish, suitable for outdoor use.
 - 5. Provide engraved lamacoid plate under bell lettered "Building Fire Sprinkler System."
- D. Audible/Visual Alarm Notification Appliances (Horn/Strobe):
 - 1. Standard: UL 1971 combination horn and strobe appliance.
 - 2. Horn: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.
 - 3. Strobes: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch (25-mm) high letters on the lens.
 - 4. Audible/visual notification appliance shall be exterior, weatherproof with weatherproof backbox.
- E. Water Flow Indicators:
 - 1. Standard: UL 346.
 - 2. Water-Flow Detector: Electrically supervised.
 - 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field-adjustable retard element to prevent false signals and tamperproof cover.
 - 4. Type: Paddle operated.
 - 5. Pressure Rating: 250 psig.
 - 6. Design Installation: Horizontal or vertical.
- F. Pressure Switches – Water Flow Alarm Detection:
 - 1. Standard: UL 346.
 - 2. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory set, field adjustable retard element to prevent false signals and tamperproof cover.
 - 3. Type: Electrically supervised water flow switch with retard feature.
 - 4. Pressure Rating: 250 psig.
 - 5. Design Operation: Rising pressure signals water flow.
- G. Pressure Switches – Low/High Air Pressure Supervisory:

1. Standard: UL 346.
2. Components: Two single-pole, double-throw circuit switches for isolated alarm contacts, 7 A, 125-V ac and 0.25 A, 24-V dc.
3. Type: Electrically supervised pressure supervisory switch
4. Pressure Rating: 250 psig.
5. Design Operation: Rising pressure signals excessive supervisory air pressure within the system piping, with lowering pressure signals lack of air pressure within the system piping.

H. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled valve is in other than fully open position.

I. Indicator Post Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts and tamperproof cover.
4. Design: Signals that controlled indicator post valve is in other than fully open position.

2.9 SPRINKLER WATERFLOW AND SUPERVISORY SYSTEM

A. Provide a Sprinkler Waterflow and Supervisory System control panel in accordance with NFPA 13 and NFPA 72.

1. UL listed, microprocessor based fire alarm control/communicator that provides addressable point monitoring or supports a minimum of 5 zones providing supervising station service. Microprocessor shall be capable of continuously monitoring and reporting system status of AC, standby battery, inputs and telephone line connections. In the event of a fault condition a local audible sound shall be activated and reported to supervising station.
2. Shall have one notification appliance circuit for connection of the exterior bell or horn/strobe.
3. A keypad shall be provided and mounted adjacent to the fire sprinkler remote dialer.
4. Power requirements: primary power, 20-V ac, 60 Hz, 600 mA max; secondary rated 18-V ac, 40 VA. Backup battery: 12-V dc, 7 AH min to 14 AH max, lead acid (gel type).
5. Provide two telephone lines for off site system monitoring in accordance with NFPA 72. Other monitoring methods permitted by NFPA 72 may be used subject to Engineer approval.

B. Supervisory System Wire and Cable

1. Power Branch Circuits: Building wire as specified in Division 26.
2. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.
3. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.
4. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.
5. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.
6. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.

3.2 PREPARATION

- A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

3.3 WATER SUPPLY CONNECTION

- A. Connect sprinkler piping to water service piping for service entrance to building. Do not connect to underground supply until provided with written documentation that piping has been flushed and pressure tested in accordance with NFPA 13. Comply with requirements for exterior piping in Division 21 Section 211100 "Fire Suppression Water Service Piping."
- B. Connect sprinkler piping to building's interior water distribution piping. Comply with requirements in Division 22 Section 221116 "Domestic Water Piping" for interior piping.
- C. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section 211100 "Fire Suppression Water Service Piping."
- D. Wet pipe systems shall be equipped with a listed relief valve not less than ½-inch in size and set to operate at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.

3.4 PIPE APPLICATIONS

- A. Piping Below Grade: Refer to Division 21 Section 211100 "Fire Suppression Water Service Piping."
- B. Piping Above Grade: Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

3.5 PIPING INSTALLATIONS

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general fire suppression piping installation requirements.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Hangers and Supports: Comply with the requirements of NFPA 13. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems. Provide protection from damage where subject to earthquake if required by the applicable building code, designed in accordance with NFPA 13. Locate hangers at or directly adjacent to the joist panel points. Provide two nuts on threaded supports to securely fasten the support.
- D. Install test connections sized and located in accordance with NFPA 13 complete with shutoff valve. Test connections may also serve as drain pipes.
- E. Install pressure gauge on the riser or feed main at or near each test connection. Provide pressure gauge with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining

pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

- F. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- G. Drain dry-type sprinkler system piping.
- H. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices
- I. Fill wet-type sprinkler system piping with water.
- J. Connect compressed air supply to dry pipe sprinkler piping.
- K. Connect air compressor to the following piping and wiring:
 - 1. Pressure gauges and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including high- and low-pressure alarm.
- L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods"
- M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods."

3.6 PIPE JOINT CONSTRUCTION

- A. Refer to Division 21 Section 210515 "Basic Fire Suppression Piping Materials and Methods" for general pipe joint construction requirements.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable water supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain line connection.
 - 3. Deluge/Preaction Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed air supply piping. Connect 1/4 inch compressor outlet with the 1/4 inch pipe through a shutoff valve to the system side of the deluge valve. Adjust pressure switch to the required setting.
 - b. Air Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to

maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.

3.8 SPRINKLER INSTALLATIONS

- A. Use proper tools to prevent damage during installations.
- B. Areas with ceilings: Install sprinklers not less than 6-inches from the edge of a ceiling tile in areas with suspended ceilings, in a symmetrical pattern with lights and outlets.
- C. Install sprinklers in suspended ceilings in center or quarter point of acoustical ceiling panels, in a symmetrical pattern with lights and outlets.
- D. Install sprinklers in a symmetrical pattern with lights and outlets in all other areas with ceilings.
- E. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- F. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- G. Do not install more than one sprinkler on a one inch outlet unless hydraulic calculations are included to verify performance.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Division 21 Section 210553 "Identification for Fire Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform required tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire alarm tests. Operate as required.
 - 7. Coordinate with fire pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire department equipment.
- C. Replace piping system components that do not pass the test procedures specified, and retest repaired portion of the system.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 COMMISSIONING

- A. Sprinkler Systems: Test per NFPA 13, NFPA 25 and local authorities requirements. Submit Contractor's Material & Test Certificates for Above Ground Piping. Submit certificates of completion to Authority Having Jurisdiction and Owner.
 - 1. After completion of all installation, tests, etc., and prior to the opening date, the Sprinkler Subcontractor shall instruct the building personnel in the operation of the sprinkler system. Special care shall be taken to make sure the building personnel:
 - a. Will immediately recognize whether the system control valves are in an 'Open' position or a 'Closed' position.
 - b. Will know how to drain the system.
 - c. Will know how to test the flow switches, tamper switches and alarm system.
 - d. Will know how to test the dry pipe/preaction valve.
 - e. Will know how to make complete weekly inspection.
 - f. Will know how to perform periodic maintenance of the Fire Sprinkler System.
- B. Fire Alarm Equipment: Test per NFPA 25, NFPA 72 and local authorities requirements in the presence of the Owner. Submit certificates of completion to authority having jurisdiction and Owner.
- C. Preaction System: Test per NFPA 13, NFPA 25, NFPA 72 and local authorities requirements in the presence of the Owner. Submit certificates of completion to authority having jurisdiction and Owner.

END OF SECTION

SECTION 13940 (213116) - DIESEL-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. The extent of this fire pump system shall be as specified herein. Contractor shall be responsible for preparation of design drawings, hydraulic calculations, fabrication, and installation for complete fire pump system for the building.
- B. Section Includes:
 - 1. Single-stage, split-case fire pumps.
 - 2. Diesel engine.
 - 3. Fire-pump accessories and specialties.
 - 4. Fuel oil storage.
 - 5. Grout.
- C. Related Requirements:
 - 1. Division 21 Section 13900 (210010) "General Fire Suppression Requirements" for requirements for hydraulic calculations, obtaining electronic drawings files, shop drawings and record drawings.
 - 2. Division 21 Section 13905 (210500) "Common Work Results for Fire Suppression," for materials and methods for wall and floor penetrations.
 - 3. Division 21 Section 13907 (210515) "Basic Fire Suppression Piping Material and Methods," for general piping and fitting materials and methods.
 - 4. Division 21 Section 13911 (210553) "Identification for Fire Suppression Piping and Equipment" for labeling and identification of installed fire suppression equipment.
 - 5. Division 21 Section 13925 (211100) "Fire Suppression Water Service Piping" for fire suppression piping starting 5 feet outside the building to within the building.
 - 6. Division 21 Section 13930 (211313) "Water Based Fire Suppression Systems" for fire suppression sprinkler systems inside the building.

1.2 SYSTEM DESCRIPTION

- A. General: Provide a diesel, horizontal split case fire booster pump, complete with jockey pump, fire and jockey pump controllers and all necessary equipment and accessories to supply the sprinkler and/or standpipe system. The fire booster pump, associated equipment and piping shall be installed where indicated on the Drawings. Provide in accordance with the latest issue of NFPA 20.
- B. Pump Conditions: Remote indication of all monitor switches, circuit breaker open, low pump room temperature (below 45° F), pump running, and all signals required by NFPA 20. Reference: Division 26 for WIRING.
- C. Quality Assurance: Pump manufacturer shall have unit responsibility for proper operation of the complete unit, and provide services of a factory trained technician to supervise installation, and to attend final field acceptance tests.
- D. Operation: The fire booster pump shall be connected to an automatic water supply and supply the fire sprinkler system(s). Fire pump shall be automatic starting following pressure loss within the sprinkler system. All drains shall be piped to the exterior of the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire pump.
 - 2. Include rated capacities, operating characteristics, certified performance test curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each fire pump.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of fire pumps.
 - 4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For fire pumps.
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fire pump.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.
- B. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- C. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.
- D. Field quality-control reports to include pump acceptance test documentation.

1.6 QUALITY ASSURANCE

- A. Contractor shall be responsible for all permits and fees associated with preparation and approval of Drawings and the installation and approval of a fire booster pump.
- B. Tests and Inspections: Arrange, test, and pay for all tests required by code and authorities having jurisdiction.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."
- E. Source Limitations: Obtain fire pump controllers and all associated equipment from single source or producer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

- A. Ambient Temperature Rating: Not less than 40 deg F (5 deg C) and not exceeding 122 deg F (50 deg C) unless otherwise indicated.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate layout and installation of controllers with other construction including conduit, piping, fire pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire pump drivers

2.1 PERFORMANCE REQUIREMENTS

- A. Environmental Conditions:
 - 1. Ambient Temperature: 17 to 85 deg F.
 - 2. Relative Humidity: 57 to 80 percent.
 - 3. Altitude: Sea level to 597 feet.
- B. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

2.2 ASSEMBLY DESCRIPTION

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Finish: Red paint applied to factory-assembled and -tested unit before shipping.
- C. NFPA Compliance: Comply with NFPA 20.

2.3 SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

- A. Available Manufactures:
 - 1. Patterson Pump Company
 - 2. Peerless Pump; Groudfos Group.
 - 3. SPP Pumps

- B. Pump:
 - 1. Standard: UL 448, for split-case pumps for fire service.
 - 2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
 - 3. Impeller: Double suction, cast bronze, statically and dynamically balanced, and keyed to shaft.
 - 4. Wear Rings: Replaceable bronze.
 - 5. Shaft and Sleeve: Alloy-steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
 - 6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

- C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.

- D. Capacities and Characteristics:
 - 1. Rated Capacity: 2500 gpm.
 - 2. Total Rated Head: 175 psig..
 - 3. Inlet Flange: Class 250.
 - 4. Outlet Flange: Class 250.
 - 5. Engine Horsepower: To be determined by contractor.
 - 6. Engine Speed: To be determined by contractor.
 - 7. Fuel Tank Capacity: To be determined by contractor.
 - 8. Rotation: Clockwise.
 - 9. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phase: Three
 - c. Hertz: 60.
 - d. Full-Load Amperes: Verify with manufacturer.

2.4 DIESEL ENGINE

- A. Fuel: Fuel oil, Grade DF-2.

- B. Horse Power Rating: Not less than 110 percent of maximum brake horsepower (after derating for temperature and elevation according to NFPA 20).

- C. Emergency Manual Operator: Factory wired for starting and operating standby engine in case of malfunction in main controller or wiring.

- D. Controls:
 - 1. Adjustable governor.
 - 2. Over-speed shutdown.
 - 3. Manual reset, speed switch.
 - 4. Instrument panel with tachometer, oil pressure gage, water temperature gage, and hour meter.

- E. Fuel System:
 - 1. Comply with NFPA 20.
 - 2. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 3. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
 - 4. Flexible metallic fuel lines.
 - 5. Inline fuel filter.

6. Oil pressure safety switch.
 7. Air cleaner.
 8. Engine-driven oil pump.
 9. Enclosed control wiring electric starter with voltage regulator.
 10. Double-Wall Storage Tank: Size indicated, but not less than required by NFPA 20; with floor legs, direct-reading level gage.
- F. Exhaust System:
1. Piping: ASTM A53/A53M, Type E or S, Schedule 40 black steel pipe; ASME B16.9 weld-type pipe fittings; ASME B16.5 steel flanges; and ASME B16.21 nonmetallic gaskets.
 2. Fabricate double-wall, ventilated thimble from steel pipe.
 3. Flexible exhaust connector.
 4. Industrial exhaust silencer with spark arrestor.
 5. Exhaust Piping Insulation: Provide removable insulation blanket rated to 1200 degrees F. Blanket as manufactured by Firwin Corporation, North York, Ontario, Canada,
- G. Rated Engine Speed: 1800 rpm.
- H. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- I. Engine- or Skid-Mounted Lubrication System:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- J. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system.
- K. Cooling System, Factory-Mounted Radiator:
1. Factory installed, closed loop, liquid cooled, with radiator factory mounted on fire-pump mounting frame and integral engine-driven coolant pump.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded-steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure, with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- L. Muffler/Silencer, Industrial Type: Sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 12 dB at 500 Hz.
 2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 87 dBA or less.

- M. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- N. Starting System: 24-V dc, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: 60 seconds.
 - 4. Battery: Adequate capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
 - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place.
 - 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 - 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1 wall-mounted cabinet.

2.5 FIRE-PUMP ACCESSORIES AND SPECIALTIES

- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
 - 1. Install at high point of suction piping.
- B. Circulation Relief Valves: UL 1478, bronze or cast iron, spring loaded; for installation in pump-discharge piping.
- C. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- D. Outlet Fitting: Concentric tapered reducer at pump-discharge outlet.
- E. Discharge Cone: Open type.
- F. Hose Valve Manifold Assembly:
 - 1. Standard: Comply with requirements in NFPA 20.

2. Header Pipe: ASTM A53/A53M, Schedule 40 galvanized steel, with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4 galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: Complying with UL 1726.
5. Manifold:
 - a. Test Connections: Comply with UL 405, except provide outlets without clappers instead of inlets.
 - b. Body: Exposed-type, brass or ductile iron, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; rectangular.
 - d. Hose valves in "Hose Valves" Subparagraph below are typically unnecessary; retain if required.
 - e. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
 - f. Exposed Parts Finish: Rough brass.
 - g. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.6 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Day Tank: UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:
 1. Containment: Integral rupture basin, with a capacity of 150 percent of nominal capacity of day tank.
 - a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
 2. Tank Capacity: As recommended by engine manufacturer.
 3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
 4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
 5. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
- C. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 1. Tank level indicator.
 2. Capacity: Fuel for eight hours' continuous operation at 100 percent rated power output.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.7 FIRE PUMP CONTROLLERS

- A. Manufacturer
 1. Subject to compliance with requirements provide pumps by one of the following manufacturers.
 - a. Firetrol, Inc.
 - b. Tornatech
 2. The fire pump controller to be a factory assembled, wired and tested unit. The controller to be of the combined manual and automatic type designed for diesel engine operation of the fire pump.
- B. Standards, Listings & Approvals
 1. Controller to conform with requirements of the latest editions of: NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection NFPA 70, National Electrical Code. The controller shall be listed in accordance with UL218, Standard for Fire Pump Controllers.

C. Enclosure

1. House controller components in a NEMA Type 2 (IEC IP22) drip-proof, wall mounted enclosure.

D. Operator Interface

1. The fire pump controller shall display motor operating conditions, including all alarms, events, and pressure conditions required by NFPA 20 and NFPA 72. All alarms, events, and pressure conditions shall be displayed with a time and date stamp with a multi-line digital display.
2. Digital display must indicate text messages for the status and alarm conditions of the following:
 - a. Engine Run
 - b. Remote Start
 - c. Minimum Run Time / Off Delay Time
 - d. Manual Engine Crank
 - e. Engine Fail To Start
 - f. Electric Control Module (ECM) Warning
 - g. Drive Not Installed
 - h. ECM Failure
 - i. Disk Error
 - j. Low Suction Pressure PLD (Pressure Limiting Driver) if so equipped
 - k. Sequential Start Time
 - l. High Cooling Water Temperature
 - m. Clogged Cooling Water Strainer
 - n. Crank/Rest Time Cycle
 - o. Low Engine Temperature
 - p. Interstitial/Fuel Spill
 - q. Pressure Error
3. The Sequential Start Timer and Minimum Run Timer/Off Delay Timer shall be displayed as numeric values reflecting the value of the remaining time.

E. Automatic Operation

1. Pressure switch actuated. Water pressure actuated switch and solid state pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire suppression piping.
2. Programmable minimum-run-time relay to prevent short cycling.
3. Programmable timer for weekly tests.
4. Controller Sensing Pipes. Pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch orifice.
5. Solid State Pressure Transducer
 - a. Systems using analog pressure devices or mercury switches for operational control will not be accepted.
 - b. Provide controller with a solid state pressure transducer with a range of 0-300 psi (0-20.7 bar) ± 1 psi.
 - c. Solid state pressure transducer must be used for both display of the system pressure and control of the fire pump controller.
 - d. The start, stop, and system pressures must be digitally displayed and adjustable through the user interface.
 - e. The pressure transducer must be mounted inside the controller to prevent accidental damage. Field connections must be made externally at the controller coupling to prevent distortion of the pressure switch element and mechanism.

F. Manual Operation

1. Door Mounted Manual START, STOP, and AUTO push buttons, membrane keypad, or hand switch.

G. Local and Remote Alarm and Status Indicators

1. Provide LED alarm and status indicating lights
2. The following conditions must be visible with the controller door closed
 - a. AC Power Available
 - b. Alarm
 - c. Main Switch in Auto
 - d. Main Switch in Manual
 - e. System Pressure Low
 - f. Engine Running
 - g. Engine Fail to Start
 - h. Engine Temperature High
 - i. Engine Oil Pressure Low
 - j. Engine Overspeed
 - k. Engine Alternate ECM
 - l. Engine Fuel Injector Malfunction
 - m. Fuel Level Low
 - n. Automatic Shutdown Disabled
 - o. Charger Malfunction
 - p. Battery #1 Trouble
 - q. Battery #2 Trouble

H. Nameplate

1. Provide nameplate with capacity, characteristics, approvals and listings, and other pertinent data.

I. Controller Operation

1. Controller to be field programmable for manual stop or automatic stop. If set for automatic stopping, the controller shall allow the user to select either a Minimum Run Timer or an Off-Delay Timer. Both timers shall be programmable through the user interface.
2. Controller to include an AC Power Loss start timer to start the engine in the event of AC Power failure.
3. Provide weekly test timer. The controller must have the ability to program the time, date, and frequency of the weekly test.
4. Provide a lamp test feature.
5. Provide audible test feature to test the operation of the audible alarm device.

J. Battery Chargers

1. Controller to include two fully automatic battery chargers. The chargers shall verify that batteries are not defective and are capable of accepting a charge.
2. The battery charger must include selectable AC power voltage, selectable battery voltage, selectable battery type, and charge cycle reset.

K. Finish: Manufacturer's standard red coating or paint

2.8 PRESSURE MAINTENCE PUMPS

A. Available Manufacturers:

1. Grundfos, Grundfos Group

B. Description: Factory-assembled and -tested, vertical, multistage, open-line-shaft turbine pump as defined in HI 2.1-2.2 and HI 2.3; with pump motor mounted above pump head. Include base.

C. Pump Construction:

1. Pump Head: Cast-iron, for surface discharge, with flange except connections may be threaded in sizes in which flanges are not available.
2. Pump Head Seal: Stuffing box and stuffing.
3. Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
4. Line Shaft Bearings: Rubber sleeve, water lubricated.
5. Impeller Shaft: Monel metal or stainless steel.
6. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.

D. Motor:

1. Single speed with permanently lubricated ball bearings.
 - a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Base: Cast-iron or steel with hole for electrical cable.

F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

G. Capacities and Characteristics:

1. Rated Capacity: 20 GPM.
2. Rated Head: To be determined by contractor.
3. Working Pressure: 175 psig.
4. Suction Head Available at Pump: To be determined by contractor.
5. Motor Horsepower: To be determined by contractor.
6. Motor Speed: To be determined by contractor.
7. Electrical Characteristics:
 - a. Volts: 240.
 - b. Phases: Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: Verify with manufacture

2.9 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

A. Available Manufacturers:

1. Firetrol, Inc.
2. Tornatech

B. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, wired, and tested, across-the-line; for combined automatic and manual operation.
2. Enclosure: UL 508 and NEMA 250, Type 2 for wall mounting.
3. Factory assembled, wired, and tested.
4. Finish: Manufacturer's standard red coating or paint.

C. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch.
2. Pressure switch.
3. Hand-off-auto selector switch.
4. Pilot light.

2.10 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.11 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold or physically damaged.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting:
 - 1. Install fire pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 21.
 - 2. Attach pumps to equipment base using anchor bolts.
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately, so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 13907 (210515) "Basic Fire Suppression Piping Materials and Methods".
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tapings. Comply with requirements for pressure gages specified in Section 13907 (210515) "Basic Fire Suppression Piping Materials and Methods".

- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Install fuel system according to NFPA 20.
- I. Install water supply and drain piping for diesel-engine heat exchangers. Extend drain piping from heat exchangers to point of disposal.
- J. Install exhaust-system piping for diesel engines. Extend to point of termination outside structure. Install pipe and fittings with welded joints; install components having flanged connections with gasketed joints. Install insulation and jacketing on exhaust piping.
- K. Install condensate-drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system to condensate traps and to point of disposal.
- L. Electrical Wiring: Install electrical devices furnished by equipment manufacturers that are not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- M. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- N. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79-inches above finished floor, and bottom of enclosure not less than 12-inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- O. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12-inches above finished floor. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
- P. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
 - 1. Comply with NEMA ICS 15.

3.3 ALIGNMENT

- A. Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.

- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.4 CONNECTIONS

- A. Coordinate fire-suppression piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping and valves specified in Section 13907 (210515) "Basic Fire Suppression Piping Materials and Methods". Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to pumps and equipment to allow service and maintenance.
- D. Connect relief-valve discharge to drainage piping or point of discharge.
- E. Provide drains for bases and seals, piped to and discharging into floor drains.
- F. Connect fire pumps and pressure-maintenance pump to their controllers.
- G. Connect controllers to their dedicated pressure-sensing lines.
- H. Provide for fire pump controller connection to building fire-alarm system. Refer to Division 28, "Fire Detection and Alarm".

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.6 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for diesel-engine-driver fire-pump controllers.
- B. Final Checks before Startup: Perform the following preventive maintenance operations and checks:
 - 1. Lubricate oil-lubrication-type bearings.
 - 2. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
 - 3. Inspect and Test each controller component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
 - c. Test continuity of each circuit
- C. Manufacturer's Field Service: Engage a factory-authorized representative to test and inspect components, assemblies, and equipment installations, including connections.
 - 1. Perform the following test and Inspections.
 - a. After installing components, assemblies, and equipment, including controller, test for compliance with requirements.

- b. Test according to NFPA 20 for acceptance and performance testing.
- c. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- d. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- e. Verify and Test each Diesel-Driver Controller.
- f. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- g. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- h. Prepare test and inspection reports

D. Field Acceptance Tests:

- 1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Engineer and authorities having jurisdiction.
- 2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
- 3. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire pump test water. Hoses are for tests only and do not convey to Owner.
- 4. Furnish all equipment required to conduct field acceptance tests to include play pipes, hose monsters, pitot tubes, gauges, ammeter, voltmeter, tachometer, etc.

3.7 ADJUSTING

- A. Adjust controllers to function smoothly and as recommended by manufacturer.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
- C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- D. Set field-adjustable pressure switches.

3.8 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions,

3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION

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SECTION 13220 (213220) – WATER STORAGE TANK (FIRE SUPPRESSION)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water storage tank for fire suppression.
 - 2. Pipe freeze protection.
- B. Related Requirements:
 - 1. Section 02510 - Water Distribution Systems.
 - 2. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 - 3. Section 13900 – (210010) Fire Suppression.
 - 4. Section 13920 (213116) - Fire Pumps.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. Factory Mutual System (FM):
 - 1. Approval Guide.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 22 - Standard for Water Tanks for Private Fire Protection.
 - 2. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
- D. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.
- E. Underwriters Laboratory (UL):
 - 1. UL Fire Protection Directory.
- F. American Water Works Association (AWWA):
 - 1. AWWA D100 - Welded Steel Tanks for Water Storage
 - 2. AWWA D102 - Coating Steel Water-Storage Tanks
 - 3. AWWA D103 - Factory-Coated Bolted Steel Tanks for Water Storage

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

1.4 SUBMITTALS

- A. Submittal shall include, but is not limited to, the following:
 - 1. Shop Drawings: Tank fabrication and erection details. Cross sections and submittal data. Provide drawings of tank shell, roof, floor, inlet and outlet piping, valves, ladders, heaters, insulation, freeze protection of valves, controller and power wiring diagrams, interior and exterior paint.
 - 2. Structural calculations (including seismic).
 - 3. Pad preparation information and foundation details.
 - 4. Start-up instructions.
 - 5. Additional data as may be required by NFPA 13 and Owner’s Fire Protection Consultant.
- B. Submittal Procedure:
 - 1. Reference Section 01330 for general submittal procedures. Conform to provisions of Section 01330 unless otherwise specified herein.
 - 2. Within 30 days after award of contract, send submittals to Owner’s Fire Protection Consultant as specified Section 01330. Allow 30 day turn-around on submittals sent to Owner’s Fire Protection Consultant.
 - a. If the Contractor fails to submit a complete Fire Suppression submittal package within 30 days, the Contractor shall pay the Owner \$250.00 per day as liquidated damages and not as a penalty, until the fully completed Fire Suppression submittal package is received by Owner’s Fire Protection Consultant.
 - 3. Submittals shall be complete, accurate, and in full compliance with contract requirements for proper

- and timely approval.
4. Contractor shall respond to shop drawing review comments within 15 days of receipt.
 5. Maintain two copies of approved documents on site.
- C. Submittal Rejection:
1. Owner's Fire Protection Consultant will reject submittals which do not comply with Contract Documents. If submittal is rejected by Owner's Fire Protection Consultant for any reason, Owner will back-charge the Contractor \$200.00 via Change Order, to cover the processing costs of each subsequent review until submittal is approved. Submittal rejections include, but are not limited to, the following reasons:
 - a. Design Issues: Incorrect, missing, or incomplete system design.
 - b. Incorrect Material: Do not propose products not specified in the Contract Documents.
 2. Rejected submittals shall be revised and resubmitted until approved. Extension of time will not be allowed for rejected submittals.
 - a. Fire Suppression subcontractor shall revise and resubmit rejected submittals within 15 days of receipt of rejected submittals.
 - b. Contractor shall verify that the Fire Suppression subcontractor has addressed all required revisions in the resubmittal.
- D. Contract Closeout Submittals: Submit the following under provisions of Section 01770.
1. Maintenance Data: Include components of system, servicing requirements, inspection data, and owners manuals.
 2. Contractors Material Test Certificates: Provide Copies of completed Contractor's Material Test Certificates.
 3. As-Built shop drawings indicating installed location of components.
 4. Contractors Record Letter of Conformance for Fire Suppression: Submit under provisions of Section 13900.
 5. At Project completion, present to the Store Manager the As built Drawings enclosed in a plastic pipe tube (fixed cap at one end and a threaded-cap on the other end) for storage in the Riser Room.
 6. In addition to the copies of Documents delivered to the Store Manager, distribute additional copies of documents as indicated below:
 - a. Contractor shall deliver copies of the As-Built shop drawings and Contractor's Material Test Certificates in both hard copy and electronic form (*.pdf or *.plt) to Owner's Fire Protection Consultant.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 22, "Water Tanks for Private Fire Protection," for surface water-storage tanks for fire-suppression water supply.
- B. Qualifications (Fabricator): Company specializing in performing work of this Section with minimum three year experience. Water storage tank drawings shall be prepared, signed, and sealed by a Registered Professional Engineer (Structural Discipline) in the state where the project is located.
- C. Regulatory Requirements: Provide certificate of compliance from Authorities Having Jurisdiction indicating approval of field acceptance tests.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products to site under provisions of Section 01600.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide UL Listed or FM Approved materials complying with NFPA 22.

2.2 WATER STORAGE TANK

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following manufacturers:
 1. Tank Connection, Contact David Mann; 620-423-3010 Ext. 233; .
 2. Pittsburg Tank and Tower, Contact Greg Garber; 757-422-1882; .
 3. CST Storage. Contact Erik Carson; 913-748-4567; .
 4. Tarsco Bolted Tank, Inc., Contact Chris Coté; 417-434-7201; chris.cote@tfwarren.com.

B. General Description:

1. Provide welded or bolted NFPA 22 compliant or FM Approved water storage tank.
2. Minimum tank volume shall be as shown on plans.
3. Provide site preparation, pad preparation and design, tank foundation and design per site conditions, tank manufacturers criteria and requirements of Contract Documents and Authorities Having Jurisdiction.
4. Provide Water Storage Tank accessories per NFPA 22 and Authorities Having Jurisdiction, including, but not limited to:
 - a. Fixed ladders with safety cage and chain on the outside of the tank per NFPA 22 requirements. Provide an inside ladder with safety-harness system per NFPA 22 requirements.
 - b. 360 degree handrail around perimeter tank roof.
 - c. Two manholes 24" in diameter or 24" square with centerline approximately 2'-0" above the bottom of the tank.
 - d. Overflow pipe and minimum of 3' x 3' x 6" concrete splash block at overflow discharge (unless noted otherwise).
 - e. Two lockable, rainproof roof manways; one at exterior ladder, one at opposite side of roof.
 - f. Roof vent equipped with insect proof galvanized, or stainless steel screen (#24 mesh or finer).
 - g. Water level gauge.
 - h. Low level tank switch, Potter Electric Signal, model WLS installed not more than 6 inches below the overflow water level. Substitutions not permitted.
 - i. Low-Low level tank switch, Potter Electric Signal, model WLS. Substitutions not permitted.
 - j. Tamper switch on the main drain to the tank.
 - k. Insulation with minimum R-value of 10.
 - l. Immersion Tank Heaters: Chromalox Model STFX or equal, to maintain a minimum temperature of 42° F during a design of one-day mean temperature of [15]^o degrees F per NFPA 22. Heater shall be capable of being replaced without draining the tank.
 - m. Low temperature alarms on tank. Potter Electric Signal, model TTS. Substitutions not permitted.
 - n. Provide lightning protection in accordance with NFPA 780 requirements.]
5. Welded Tank: Provide finishes and surface preparation per Contract Documents, NFPA 22 and Authorities Having Jurisdiction. Submit to Architect for exterior finish color approval.
 - a. Paints and materials used on interior surfaces shall be accepted by the AWWA, EPA, and NSF for potable water service. Provide certification to Owner.
 - b. Finish coat painting for interior surfaces exposed to stored water shall be in accordance with NFPA 22 and AWWA D102, "Inside Paint System No. 1," using the basic system throughout.
 - c. Finish coat painting for exterior surfaces shall be in accordance with NFPA 22 and AWWA D102, "Outside Paint System No. 4," using three coats of aluminum or alkyd enamel to provide a minimum total system dry film thickness of 5.0 mils for aluminum finishes and 6.0 mils for alkyd enamels.
 - d. Where spot-blast cleaning is required, use tools and methods to maintain dust emissions below the permissible level. Abrasive used in spot-blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating of paint. Abrasive shall not be reused.
 - e. Protect site, equipment, buildings, vehicles, and property from cleaning and painting operations.
 - f. Maintain clean work area.
 - g. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.
 - h. Repair holidays and defects discovered during inspection with the same material as used for the original finish coats. Excessive low film thickness will require extra full coat (s) of paint.
6. Bolted Tanks: Provide finishes and surface preparation per Contract Documents, NFPA 22 and Authorities Having Jurisdiction. Submit to Architect for exterior finish color approval.
 - a. Paints and materials used on interior surfaces shall be accepted by the AWWA, EPA, and

NSF for potable water service. Provide certification to Owner.

- b. Coatings shall be applied in accordance with AWWA D103.
- c. After erection, touch up paint per manufacturer's instructions.

2.3 SUBSTITUTIONS

- A. Reference Section 01600.

2.4 FIRE PROTECTION PIPING - BELOW GROUND

- A. Refer to Section 13900 for requirements.

2.5 FIRE PROTECTION PIPING - ABOVE GROUND

- A. Piping: Refer to Section 13900 for requirements.
 - 1. Use galvanized pipe, zinc coated internally and externally, outdoors, inside coolers and freezers, in non-conditioned spaces including exterior insulated piping or submerged piping.
- B. Fittings: Refer to Section 13900 for requirements.
 - 1. Fitting type shall match pipe. Galvanized fittings shall be used for areas where galvanized piping is required.

2.6 FREEZE PROTECTION

- A. Freeze protection system shall be installed on above-ground tank fill piping, fire pump suction piping, and tank drain valve.
- B. Freeze protection shall include the following:
 - 1. Parallel circuit heating cable.
 - 2. Transformers.
 - 3. Ambient sensor and controller with fire alarm supervisory capability.
 - 4. Junction boxes.
 - 5. Branch circuit wiring and conduit as specified in Section 16100.
 - 6. Other items as necessary to complete system.
- C. Components:
 - 1. Heating Cable: Parallel circuit, jacketed cable, self-limiting, as shown on the drawings. Provide XL-Trace as manufactured by Raychem or Model SRL by Chromalox
 - a. Provide minimum 5810 watts per lineal foot as required for specified piping and insulation per manufacturer's published instructions.
 - b. Provide termination fittings for direct connection to junction boxes.
 - 2. Junction Boxes: NEMA 3R watertight.
 - 3. Controller: Digitrace C910 by Raychem or DTS Heat Trace Digital Thermostat by Chromalox. Set thermostat to activate heat trace at 42 F on decreasing temperature.
- D. Insulation:
 - 1. Walls: Provide minimum 2 inch thick layer of polystyrene insulation panels attached to tank with cables. Overlay with 1 inch thick foil faced polyisocyanurate foam laminated to an aluminum jacket with seams not overlapping the first insulation layer, attached to cables.
 - a. Minimum R-Value = $10 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$.
 - 2. Roof: Provide minimum 2 inch thick foil faced polyisocyanurate foam laminated to an aluminum jacket. Attach to tank with cables.
 - 3. Piping (Tank to Pumphouse): Polyisocyanurate insulation, 2 inches thick, with vapor retarder film and tape. Provide Trymer 2000 XP insulation with Saran 540 Vapor Retarder by ITW Insulation Systems, Houston, TX, or equivalent.
 - a. All piping shall have aluminum jacket attached with bands. Do not secure jacketing with screws or rivets.
 - 4. Spray on insulation not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Erect tank shell, accessories, and appurtenances according to NFPA 22 and AWWA D100.
- B. Fabricate steel plate sections in the shop.
 - 1. Welded Tanks: Erect welded steel tank shell by welding plate sections in the field.
 - 2. Bolted Tanks: Drill or punch bolt holes in the shop. Install bolts during field erection of tank.
- C. Set top of reinforced-concrete foundation at least 6 inches above finish grade.

3.2 INSTALLATION - BELOW GROUND PIPING

- A. Refer to Section 13900 for requirements.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Refer to Section 13900 for requirements

3.4 FREEZE PROTECTION

- A. Install heating cable at locations shown on drawings for pipe freeze protection.
- B. Cut heating cable to length required for pipe lengths and watt per foot requirements.
- C. Install heating cable in accordance with manufacturer's published instructions.
- D. Provide conduit for fire alarm control panel monitoring cable to controller.

3.5 FIELD QUALITY CONTROL

- A. General – Refer to Section 13900 for requirements.

- B. Site Tests - Water Storage Tank:

- 1. Test per NFPA 22.
- 2. Provide personnel and equipment necessary for complete start up and acceptance testing.

- C. Site Tests - Heat Trace:

- 1. Provide personnel and equipment necessary for complete start up and acceptance testing.
- 2. Provide photographs of heat trace cable installation to Owner's Fire Protection Consultant.
- 3. Perform heat trace acceptance testing per manufacturer's instructions after completed installation.
- 4. Complete Heat Trace Installation and Commissioning Record form at the end of this Section and submit to Fire Protection Consultant.

END OF SECTION

HEAT TRACE INSTALLATION AND COMMISSIONING RECORD

Refer to Manufacturer's Installation and Operation Manual for required Commissioning Tests. All tests, as well as photographs of the heating cable installation taken prior to covering of cable with pipe insulation, are required to obtain the Fire Suppression Letter of Conformance from Owner's Fire Protection Consultant.

Store/Club:	Tank Fill	Pump Suction	Drain Valve
Test Date:			
Panel Number/Circuit Number:			
Heating cable type:			
Controller:			
Temperature setting (42°F per specification):			
Circuit length (Measured/Installed):			
Commissioning			
Visual inspection	Check/OK	Check/Ok	Check/Ok
Confirm 30-mA ground-fault device (proper rating/function).			
Visual inspection inside connection boxes for overheating, corrosion, moisture, and other problems.			
Proper electrical connection, ground, and bus wires insulated over full length.			
Damaged or missing thermal insulation; damaged, missing, cracked lagging or weatherproofing.			
Covered end seals, splices, and tees properly labeled on insulation.			
Check controllers for moisture, corrosion, setpoint, and operation.			
"Electric Traced" permanent labels provided every 10 ft. on outside of insulation sheathing			
Insulation resistance test	MΩ	MΩ	MΩ
Bus to braid	500 Vdc		
	1000 Vdc		
<i>(2500Vdc test required by Raychem only)</i>	2500 Vdc		
Circuit length verification	Check/Ok	Check/Ok	Check/Ok
Capacitance test: Circuit length (ft) = Capacitance (nF) x Capacitance factor			
Power check			
Circuit voltage			
Panel	V	V	V
Circuit amps	A	A	A
Pipe temperature	°F	°F	°F
Power = (volts x amps after 2 hrs) / circuit length (watts/ft)	w/ft	w/ft	w/ft

Installing Firm Responsible Party:

Signature: _____ Title: _____ Date: _____

Print Name: _____

Testing Firm Responsible Party:

Signature: _____ Title: _____ Date: _____

Print Name: _____

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SECTION 15011 (220010) - GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP, or MEP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

CBC	California Building Code – 2019
CMC	California Mechanical Code – 2019
CPC	California Plumbing Code – 2019
CEC	California Energy Code – 2019
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
FGI	Facilities Guideline Institute
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. Furnish: When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.” When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.

4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
 5. **Engineer:** Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
 6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 9. **Value Engineering:** A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. **Additional Excavation:** Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. **Bedding:** as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
 3. **Subbase:** as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 4. **Subgrade:** as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 5. **Unauthorized excavation** consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.
 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.

6. Indicate required installation sequence to minimize conflicts between entities.
 7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
 2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
 3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
 4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
 3. Where Henderson Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, Henderson Engineers makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
 4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.
- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
 - E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
 - F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
 - G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
 - H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
 - I. Refer to individual Sections for additional submittal requirements.
 - J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
 - K. Submittals shall contain the following information:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. Equipment identification acronym as used on the drawings.
 - 4. The submittal date.
 - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 - 6. Submittals not so identified will be returned to the Contractor without action.
 - L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.
 - M. Provide welders' qualification certificates.
 - N. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- 1.9 ELECTRONIC DRAWING FILES
- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a

drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.10 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
 - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
 - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 - 2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
 - 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in Table 5.
- F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.12 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.
- B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.13 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.14 TRAINING

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.15 PAINTING

- A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.17 GUARANTEES AND WARRANTIES

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.18 PROJECT CONDITIONS

- A. Conditions Affecting Excavations: The following project conditions apply:
 - 1. Maintain and protect existing building services which transit the area affected by selective demolition.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- B. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- C. Use of explosives is not permitted.
- D. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 SOIL MATERIALS

- A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

- F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
 - 1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
 - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for Plumbing installations as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
 - 2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 - 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
 - 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:

1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
 2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 2. Under building slabs, use drainage fill materials.
 3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
 5. Other areas, use excavated or borrowed materials.
- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- Q. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- R. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- S. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- T. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
 2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
 3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
 5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- U. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.
- V. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.3 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.
- G. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.4 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

- B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.5 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
 - 1. Submit complete Operation and Maintenance Manuals.
 - 2. Submit complete Record Drawings.
 - 3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
 - 4. Start-up testing of systems.
 - 5. Removal of temporary facilities from the site.
 - 6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 15011 (220010)

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	A, B, G, M
220515	Basic Piping Materials And Methods	B, G
220516	Expansion Fittings And Loops For Plumbing Piping	A, B, F
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	B, F, G, H
220548	Seismic Controls For Plumbing Piping & Equipment	A, B, C, D, I, M
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	B, L, M
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221328	Condensate Pumps for HVAC Equipment	A
221400	Storm Drainage Piping & Specialties	B
221500	General Service Compressed Air Systems	B, C, D, E, F, H
223300	Electric Domestic Water Heaters	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N

CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder's Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>		<u>RECEIVED/DATE/INITIAL</u>
220553	Identification For Plumbing Piping & Equipment	_____
221100	Water Distribution Piping & Specialties	_____
221123	Domestic Water Pumps	_____
224000	Plumbing Fixtures	_____

Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>		<u>RECEIVED/DATE/INITIAL</u>
223300	Electric Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>		<u>COMPLETED/DATE/INITIAL</u>
220548	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

<u>SPECIFICATION NUMBER/TITLE</u>		<u>CODE DESIGNATION</u>
220500	Common Work Results For Plumbing	B
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B
220516	Expansion Fittings And Loops For Plumbing Piping	A, B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
221500	General Service Compressed Air Systems	A, B, C, D, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
224000	Plumbing Fixtures	B, E, H, I
227000	Natural Gas Systems	A, B, C, H

CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor Date Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative Date Company

Engineer Review and Recommendation Section

Recommend Acceptance Yes No
Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature Date Company

Owner Acceptance Signature Date Company

Architect Acceptance Signature Date Company

Engineer Acceptance Signature Date Company

SECTION 15031 (220015) - COORDINATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections
- C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN	SET	POWERCONTROL	
	BY	BY	WIRING	WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches	DIV 22	DIV 22	DIV 26	DIV 23
Remote pressure switches (booster pumps)	DIV 22	DIV 22 ---		DIV 23
Temperature control panels	DIV 22	DIV 22	DIV 26	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23

DIV 22 = Plumbing Contractor

DIV 26 = Electrical Contractor

DIV 23 = Building Automation System Contractor, refer to Division 23 Section "Direct-Digital Control for HVAC".

END OF SECTION

SECTION 15051 (220500) - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:
 - 1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
 - 2. Plumbing equipment nameplate data.
 - 3. Concrete for bases and housekeeping pads.
 - 4. Non-shrink grout for equipment installations.
 - 5. Sleeves for Plumbing penetrations.
 - 6. Miscellaneous metals for support of Plumbing materials and equipment.
 - 7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
 - 8. Joint sealers for sealing around Plumbing materials and equipment.

- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
 - 2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
 - 3. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for indirect drain piping and installation requirements.
 - 4. Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system of leak detection system "Water Present" alarm.
 - 5. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 - 6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 and Division 22 Section "General Plumbing Requirements".
 - 1. Product data for the following products:
 - a. Access panels and doors.
 - b. Through and membrane-penetration firestopping systems.
 - c. Joint sealers.
 - 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.
 - 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
 - 4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."
 - 5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with

modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 - 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.4 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

Space	RC Levels
Meeting/Banquet Rooms	30
Conference Rooms	30

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. Manufacturer:
 - 1. Bar-Co., Inc.
 - 2. Elmdor Stoneman.
 - 3. JL Industries
 - 4. Jay R. Smith Mfg. Co.
 - 5. Karp Associates, Inc.
 - 6. Milcor
 - 7. Nystrom Building Products
 - 8. Wade
 - 9. Zurn
- B. Access Doors:
 - 1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Plumbing Piping" for labeling of access doors.

2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
8. Locking Devices: Flush, screwdriver-operated cam locks.
9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.2 PLUMBING EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment.. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.

- F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2"

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.5 PENETRATIONS

- A. Sleeves:
 1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
 2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
- C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.6 DRIP PANS

- A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2" lapped and soldered joints. Drip pan shall have a depth of 2" and a width of 6" in addition to the diameter of the associated pipe. Provide 3/4" galvanized pipe with male NPT outlet at low point of drip pan.
- B. Drip pan supports shall be 1/4" X 2" galvanized bar stock welded to the drip pan without holes.

2.7 LEAK DETECTION SYSTEM

- A. Leak detection system with Rope style leak sensor and controller capable of connecting to a building automation system with audible and visual alarms for leak detection and cable failure in all drip pans unless otherwise noted on drawings. Provide with factory 24V DC power supply with power plug, sensing cables, and accessories.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. RLE Technologies #LD1000

2.8 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.9 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.10 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
 - a. "Dow Corning 790," Dow Corning Corp.
 - b. "Silglaze II SCS 2801," General Electric Co.
 - c. "Silpruf SCS 2000," General Electric Co.
 - d. "864," Pecora Corp.
 - e. "Rhodia 5C," Rhone-Poulenc, Inc.
 - f. "Spectrem 1," Tremco, Inc.
 - g. "Spectrem 2," Tremco, Inc.
 - h. "Dow Corning 795," Dow Corning Corp.
 - i. "Rhodia 7B," Rhone-Poulenc, Inc.
 - j. "Rhodia 7S," Rhone-Poulenc, Inc.
 - k. "Omniseal," Sonneborn Building Products Div.
 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
 - a. "Dow Corning 786," Dow Corning Corp.
 - b. "Sanitary 1700," General Electric Co.
 - c. "898 Silicone Sanitary Sealant," Pecora Corp.

- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremflex 834," Tremco, Inc.

2.11 ACOUSTICAL SEALANTS

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m³).

2.12 FIRE STOPPING

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:
 - 1. Hilti
 - 2. RectorSeal
 - 3. Specified Technologies Inc.,
 - 4. United States Gypsum Company
 - 5. 3M Corp.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install access doors and sealants in accordance with manufacturer's installation instructions.

3.2 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

- A. New Construction:
 - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.
- B. Construction in Existing Facilities:
 - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

- E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section "Basic Piping Materials and Methods".

3.8 DRIP PANS

- A. Provide drip pans in locations indicated on drawings.
- B. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.
- C. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.
- D. Provide drip pan supports every 4'-0". Provide ¼" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.
- E. Connect ¾" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.
- F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.
- G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.
- H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section "Common Work Results for Electrical" Disconnects are specified in Division 26 Section "Enclosed Switches and Circuit Breakers"
- I. Coordinate interlock of "Water Present" alarm and "Cable Fault alarm with Building Automation System. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

3.9 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Domestic Water, Sewer, Drain and Vent Piping

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

C. Compressed Air Piping

1. Compressed air pipes may be sleeved and sealed as described above, or may be grouted and caulked into the structure as follows: before grout has set, rake a groove around the pipe on each side of the wall or slab; groove shall be 1/2 inch wide and 1/2 inch deep. After grout has set, fill groove full depth with sealant.

END OF SECTION

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SECTION 15056 (220515) - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.2 DEFINITIONS

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

- A. Refer to Division 1 and Division 22 Section "General Plumbing Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
 - 1. Escutcheons
 - 2. Dielectric Unions
 - 3. Dielectric Waterway Fittings
 - 4. Dielectric Flanges and Flange Kits
 - 5. Mechanical Sleeve Seals
 - 6. Wall Pipes
 - 7. Strainers
- C. Quality Control Submittals:
 - 1. Submit welders' certificates specified in Quality Assurance below.
- D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.
- E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.
- F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.4 QUALITY ASSURANCE

- A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

- B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.
- C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
 - 1. Pipe Escutcheons:
 - a. AWI Manufacturing.
 - b. Keeney Manufacturing Company
 - c. Wal-Rich Corp.
 - d. Jones Stephens Corp.
 - 2. Dielectric Waterway Fittings:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP
 - c. Precision Plumbing Products, Inc.
 - 3. Dielectric Unions:
 - a. JOMAR International
 - b. Smith Cooper International
 - c. Watts Regulator Co.
 - d. Zurn Industries
 - 4. Dielectric Flanges and Flange Kits:
 - a. Calpico, Inc.
 - b. FMC Technologies
 - c. Pipeline Seal & Insulator, Inc.
 - d. Tampa Rubber and Gasket Co., inc.
 - e. Watts Industries Inc.; Water Products Div.
 - f. Zurn Industries, Inc.; Wilkins Div.
 - 5. Strainers – 2” and smaller:
 - a. Apollo
 - b. Hammond
 - c. Milwaukee
 - d. NIBCO
 - 6. Strainers – 2-1/2” and larger:
 - a. Metraflex Co.
 - b. Watts Regulator Co.
 - c. Zurn Industries, Inc.; Wikins Div.
 - 7. Mechanical Sleeve Seals:
 - a. Advance Products & Systems
 - b. Calpico, Inc.
 - c. GPT Industries/Link Seal
 - d. Metraflex Co.
 - e. Proco Products, Inc.
 - 8. Wall Pipes

- a. Josam Mfg. Co.
- b. Smith (Jay R) Mfg. Co.
- c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
- d. Watts Industries, Inc.
- e. Zurn Industries, Inc.; Hydromechanics Div.

2.2 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.
- B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.
- E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.4 PIPING SPECIALTIES

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- B. Unions:
 - 1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
 - 2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.
- C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Dielectric Flanges and Flange Kits:

1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
 2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
 3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.
- F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4" and smaller shall be Type 304 stainless steel mesh with 0.062" perforations and screens for 5" and larger shall be Type 304 stainless steel, with 0.125" perforations.
1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
 2. Solder Ends, 2" and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
 3. [Threaded Ends, 2" and Smaller: Cast bronze body, screwed screen retainer with centered blowdown fitted with pipe plug.]
 4. [Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.][Threaded Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug.]
 5. Flanged Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug.
- G. Sleeves:
1. Sleeve: Refer to Division 22 Section "Common Work Results for Plumbing" for sleeve materials.
- H. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 WALL PIPES

- A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.6 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2" wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's installation instructions.

3.2 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.3 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Verify final equipment locations for roughing in.

3.4 PIPING PROTECTION

- A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.5 PENETRATIONS

- A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Above Grade Concrete or Masonry Penetrations
 - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
 - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:

- 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
 - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
- d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- C. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.
- D. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
 2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
 4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
 5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- F. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
 2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.
- G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

- H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
 - 1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.
- J. Acoustical Barrier Penetrations: Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. The internal diameter of the sleeve shall be a minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
 - 1. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.6 FITTINGS AND SPECIALTIES

- A. Use fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.
- E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.
- F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2" and larger.
- G. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.
- H. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.
- I. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.
- J. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

- K. Install dielectric waterway fittings for piping 2" and smaller for copper or brass pipe connections to carbon steel equipment connections.
- L. Install dielectric flanges for piping 2-1/2" and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.
- M. Dielectric Flange Installation:
 1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
 2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
 3. Provide full face gasket with pressure rating equal to system served.
 4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.7 JOINTS

- A. Steel Pipe Joints:
 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
 2. Pipe Larger Than 2":
 - a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
 - b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
 - c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.
- B. Non-ferrous Pipe Joints:
 1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
 2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- C. Joints for other piping materials are specified within the respective piping system Sections.

3.8 FLEXIBLE CONNECTORS

- A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.
 1. Install stainless steel connectors for domestic water copper equipment connections 2" and smaller.
 2. Install bronze connectors for non-domestic water copper equipment connections 2" and smaller.
 3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2" and larger.
- B. Install connectors according to manufacturer's recommendations.

3.9 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.
- B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION

PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM

Project Name: _____
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____ Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks

Contractor Supervisor's signature: _____

SECTION 15125 (220516) - EXPANSION FITTINGS AND LOOPS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Flexible expansion loops
 - 2. Flexible ball pipe joints
 - 3. Piped expansion loops
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Hangers and Supports for Plumbing Piping", for pipe anchors and alignment guides.
 - 2. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for shielded transition couplings.

1.2 DEFINITIONS

- A. Pipe sizes used in this Specification are nominal pipe size (NPS).
- B. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product data for each type of pipe expansion joints specified. Submit expansion compensation schedule showing manufacturer's figure number, size, location, connections, material and displacement for each required expansion joint.
 - 2. Assembly-type shop drawings for each type of expansion compensation product, indicating dimensions, weights, required clearances, and methods of assembly of components. Detail fabrication of pipe anchors, hangers, special pipe support assemblies and their attachment to the building structure. Submit calculations of pipe expansion forces at anchor points for structural engineer review.
 - 3. Shop drawings for field-fabricated expansion loops indicating location, dimensions, pipe sizes, calculations for compression or tension required, and location. Detail fabrication of pipe anchors, hangers, special pipe support assemblies and their attachment to the building structure. Submit calculations of pipe expansion forces at anchor points for structural engineer review.
 - 4. Maintenance data for expansion joints for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
 - 5. Submit certification that expansion joints for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372.
 - 6. Submit American Gas Association certification for expansion joints used for natural gas distribution systems.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following codes:

1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
- B. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- C. Expansion joints shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexible Expansion Loops:
 - a. Flex-Hose Co. Inc.
 - b. Flexicraft Industries
 - c. Keflex HVAC Products, Flex-Weld, Inc.
 - d. Metraflex Co.
 - e. Twin City Hose
 2. Packless Rubber Expansion Joints:
 - a. Flexider USA
 - b. Garlock Mechanical Packing Div., Colt Industries
 - c. Holz Rubber
 - d. Keflex HVAC Products Div., Flex-Weld, Inc.
 - e. MG Piping Products Co.
 - f. Mason Industries, Inc.
 - g. Metraflex Co.
 - h. Vibration Mountings and Controls, Subsidiary of ARX.
 3. Flexible Ball Pipe Joints:
 - a. Advanced Thermal Systems, Inc.
 - b. Barco Div., Marison Industries.

2.2 PIPE EXPANSION JOINTS, GENERAL

- A. Pipe expansion joints shall provide 200 percent absorption capacity of piping expansion between anchors.
- B. Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Fittings: Materials of construction and end fitting type shall be consistent with pipe material and equipment / pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.

2.3 FLEXIBLE EXPANSION LOOPS

- A. Expansion Compensators for domestic distribution water systems: Flexible loops shall consist of two lead free copper 90 degree elbows and one lead free copper 180 degree return assembly, such that the piping does not change direction and maintains course along a single axis. Provide with support nut at the bottom of the 180 degree return assembly for proper positioning, drain plug, and lead free bronze flexible hose and braid. Provide copper sweat ends for 2" and smaller and lead free bronze 150# flanges for 2-1/2" and larger. Units shall be minimum cold working pressure 150 psi. [Units shall be listed and labeled for UPC.]

- B. Expansion Compensators for stainless steel domestic distribution water systems: Flexible loops shall consist of two stainless steel 90 degree elbows and one stainless steel 180 degree return assembly, such that the piping does not change direction and maintains course along a single axis. Provide with support nut at the bottom of the 180 degree return assembly for proper positioning, drain plug, and stainless steel flexible hose and braid. Provide threaded ends for 2" and smaller and 150# flanges for 2-1/2" and larger. Units shall be cold working pressure 150 psi.
- C. Expansion Compensators for natural gas distribution systems: Flexible loops shall consist of two carbon steel 90 degree elbows and one carbon steel 180 degree return assembly, such that the piping does not change direction and maintains course along a single axis. Provide with support nut at the bottom of the 180 degree return assembly for proper positioning, drain plug, and stainless steel hose and braid. Provide threaded ends for 2" and smaller and steel 150# flanges for 2-1/2" and larger. Units shall be cold working pressure 150 psi. Unit shall be specifically designed for natural gas systems and bear the AGA stamp.
- D. Expansion Compensators for steel pressure or sanitary vent systems: Flexible loops shall consist of two carbon steel 90 degree elbows and one carbon steel 180 degree return assembly, such that the piping does not change direction and maintains course along a single axis. Provide with support nut at the bottom of the 180 degree return assembly for proper positioning, drain plug, and stainless steel hose and braid. Provide threaded ends for 2" and smaller and steel 150# flanges for 2-1/2" and larger for steel pressure systems. Provide with plain ends for all sizes connecting to cast iron sanitary vent systems. Units shall be minimum cold working pressure 150 psi.
- E. Expansion Compensators for gravity drainage systems: Flexible loops shall consist of two stainless steel 90 degree elbows and one stainless steel 180 degree return assembly, such that the piping does not change direction and maintains course along a single access. The 180 degree return assembly shall consist of two 90 degree elbows with brass cleanout plugs and shall be connected by 150# flanges. Provide with stainless steel hose, braid, and internal liner. Provide with plain ends for all sizes. Units shall be specifically designed for use in gravity drainage systems and be IAPMO listed.
- F. Rubber Expansion Joints: Fabric-reinforced EPDM rubber with full-faced integral flanges, external control rods and shall be internally reinforced with steel retaining rings over entire surface of flanges, drilled to match flange bolt holes.

2.4 FLEXIBLE BALL PIPE JOINTS

- A. Joints shall be designed for 360 degree rotation and with minimum of 30 degree angular deflection for sizes 6 inches and smaller; 15 degree for sizes 8 inches and larger.
- B. Joints shall be carbon steel and shall comply with Section II of ASME Boiler and Pressure Vessel Code and ASME B31.9 "Building Service Piping" for materials and design of pressure containing parts and bolting. Packing shall be asbestos composition.
 - 1. Each assembly shall be factory tested with steam at working pressure of piping system for zero leaks before shipment.

2.5 EXPANSION LOOPS

- A. Provide pipe expansion loop constructed of main pipe material. Acceptable methods include use of elbows in a U or Z shape as defined by ASHRAE or ASME; or a detailed stress analysis may be utilized to define areas of expansion.

2.6 ALIGNMENT GUIDES AND ANCHORS

- A. Provide alignment guides and anchors as specified in specification Division 22 Section "Hangers and Supports for Plumbing Piping".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install expansion joints and expansion loops where indicated on the drawings and where required for adequate expansion of installed piping system.
- C. Install expansion loops in all piping crossing building expansion joints. Expansion loops shall be sized to meet or exceed building expansion as defined in the structural documents. Expansion loops shall be capable of moving in all planes. Provide hangers and supports per manufacturer's instructions.
- D. Anchor piping to ensure proper direction of expansion and contraction
- E. Align joints to avoid end loading and torsional stress.

3.2 EXPANSION COMPENSATION FOR RISERS AND TERMINALS

- A. Install connection between piping mains and risers with at least 5 pipe fittings including tee in main. Install connections between piping risers and terminal units with at least 4 pipe fittings including tee in riser.

3.3 FLEXIBLE EXPANSION LOOPS

- A. Install loops at locations indicated on plans. Amount of expansion shall be as indicated on plans. Support loop as required by manufacturer and to prevent binding or sagging per Division 22 Section "Hangers and Supports for Plumbing Piping".
- B. Where required by manufacturer provide hanger or support for 180 degree return fitting.
- C. Flexible hose expansion loops shall impart no thrust loads to system support, anchors or building structure.

3.4 EXPANSION LOOPS

- A. Fabricate expansion loops to dimensions indicated. For thermal expansion loops subject loop to cold spring tension or compression necessary to absorb 50 percent of the total compression or tension during anticipated change in temperature.
- B. Expansion loop locations and dimensions shall be based on routing shown on plans. If routing is modified, coordinate locations with engineer.
- C. Fabricate expansion loops to dimensions indicated on plans.
- D. For thermal expansion loops, install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature. After installation remove temporary space holders as required.
- E. Provide hangers and supports in accordance with Division 22 Section "Hangers and Supports for Plumbing Piping". For expansion loops with horizontal and vertical components, support for the horizontal legs shall be designed for full weight of the pipe with maximum load variation of 25%.
- F. Provide alignment guides at locations indicated on plans and as required for piping expansion. At a minimum, install alignment guides on both sides of expansion loop, spaced at twice the height of the U or Z loop (height defined as perpendicular distance of piping from primary pipe direction) or as required by

the expansion joint manufacturer. Alignment shall be sufficient to allow for proper installation of expansion joints to prevent binding or torsional stress on joint.

- G. Provide anchors at locations indicated on plans and as required for piping expansion. At a minimum install anchors on both sides of straight pipe length incorporating expansion loop.
- H. For gravity drainage systems and vent systems, connect plain end expansion compensators to hubless cast iron with shielded transition couplings. Shielded transition couplings are specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".

END OF SECTION

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SECTION 15135 (220519) - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes the following types of meters and gauges:
 - 1. Temperature gauges and fittings.
 - 2. Pressure gauges and fittings.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
 - 2. Product certificates signed by manufacturers of meters and gauges certifying accuracy under specified operating conditions and products' compliance with specified requirements.
 - 3. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glass Tube Industrial Thermometers:
 - a. H. O. Trerice Co.
 - b. Marshalltown Instruments, Inc.
 - c. Miljoco Corporation
 - d. Weiss Instruments, Inc.
 - e. Weksler Instruments Corp.
 - f. Winters Instruments
 - 2. Thermometer Wells: Same as for thermometers.
 - 3. Pressure Gauges:
 - a. Ametek, U.S. Gauge Div.
 - b. Ashcroft Dresser Industries Instrument Div.
 - c. Ernst Gage Co.
 - d. H. O. Trerice Co.
 - e. Marsh Instrument Co., Unit of General Signal.
 - f. Marshalltown Instruments, Inc.
 - g. Miljoco Corporation
 - h. Weiss Instruments, Inc.
 - i. Weksler Instruments Corp.
 - j. WIKA Instruments Corp.
 - k. Winters Instruments
 - 4. Pressure Gauge Accessories: Same manufacturers as for pressure gauges.

2.2 THERMOMETERS, GENERAL

- A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
- B. Scale range: Temperature ranges for services listed as follows:
 - 1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).
 - 2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).

2.3 GLASS TUBE INDUSTRIAL THERMOMETERS

- A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.
- B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- C. Tube: Non-red color reading, non-toxic organic spirit-filled glass tube, magnifying lens.
- D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.
- E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.4 THERMOMETER WELLS

- A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.5 PRESSURE GAUGES

- A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.
- B. Case: Cast aluminum or stainless steel case, glass lens, 4-1/2-inches diameter.
- C. Connector: Brass, 1/4-inch NPS.
- D. Scale: White coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
 - 1. Vacuum: 30 inches Hg to 15 psi.
 - 2. All fluids: 2 times operating pressure.
- G. Liquid-Filled: Provide liquid filled gauges where specified in Part 3 of this section.

2.6 PRESSURE GAUGE ACCESSORIES

- A. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

PART 3 - EXECUTION

3.1 THERMOMETERS INSTALLATION

- A. Install in the following locations and elsewhere as indicated:
 - 1. At outlet of each domestic water heater.
- B. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.2 INSTALLATION OF PRESSURE GAUGES

- A. Install in the following locations, and elsewhere as indicated:
 - 1. Provide liquid-filled gauge at suction and discharge of each pump.
 - 2. At discharge of each pressure-reducing valve.
 - 3. At building water service entrance.
- B. Pressure Gauge Needle Valves: Install in piping tee with snubber.

END OF SECTION

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SECTION 15100 (220523) - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes general duty valves common to most plumbing water distribution piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.2 DEFINITIONS

- A. **Lead Free:** Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. **General:** Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
- B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.4 QUALITY ASSURANCE

- A. **Single Source Responsibility:** Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.
- B. **American Society of Mechanical Engineers (ASME) Compliance:** Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. **Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance:** Comply with the MSS Standard Practices below:
 - 1. MSS SP 67 “Butterfly Valves”
 - 2. MSS SP 70 “Gray Iron Gate Valves, Flanged and Threaded Ends”
 - 3. MSS SP 71 “Gray Iron Swing Check Valves, Flanged and Threaded Ends”
 - 4. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
 - 5. MSS SP 80 “Bronze Gate, Globe, Angle and Check Valves”
 - 6. MSS SP 85 “Gray Iron Globe and Angle Valves, Flanged and Threaded Ends”
 - 7. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”
 - 8. MSS SP 125 “Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided”
 - 9. MSS SP 139 “Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications”
- D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.2 VALVE FEATURES, GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems.
 - 1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
 - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 - 2. Lever handles, on quarter-turn valves 6-inch and smaller.
 - 3. Chain-wheel operators, for valves 2-1/2-inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
 - 4. Gear drive operators, on quarter-turn valves 8-inch and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. End Connections: As indicated in the valve specifications.
 - 1. Threads: Comply with ANSI B1.20.1.
 - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
 - 3. Solder-Joint: Comply with ANSI B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

- A. Gate Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body, solid wedge and bonnet of ASTM B 584 lead free cast bronze; brass packing gland and stem of ASTM B283 naval brass; with solder ends, non-asbestos composition packing, and malleable iron handwheel.
- B. Gate Valves, 2-1/2-Inch and Larger: Meeting MSS SP-70 and lead free with FDA epoxy coating; Class 125, 200-psi CWP, iron body, lead free bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with lead free brass stem, with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly.
- C. Gate Valves, 2-1/2-Inch and Larger: Meeting MSS SP-70 and lead free with FDA epoxy coating; Class 250, 500-psi CWP, iron body, lead free bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with lead free brass or steel stem, with flanged ends, non-asbestos composition packing, and two-piece packing gland assembly.

2.4 BALL VALVES

- A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, regular port, blowout-proof stem and chrome-plated lead free brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.
- B. Cast Iron Body Ball Valves, 2-1/2" and larger: Meeting MSS SP 72, 200 CWP, lead free with FDA epoxy coating, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, FDA epoxy coating, PTFE gasket, stem seal and seat.

2.5 GLOBE VALVES

- A. Globe Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP; body, disc and screwed bonnet of ASTM B 584 lead free cast bronze; brass replaceable composition disc and stem of ASTM B 283 alloy C46400 naval brass, brass packing gland, with solder ends, non-asbestos composition packing, and malleable iron handwheel.
- B. Globe Valves, 2-1/2-Inch and Larger: Meeting MSS SP-85; Class 125, 200-psi CWP; iron body and bolted bonnet conforming to ASTM A 126, Class B; with FDA epoxy coating, outside screw and yoke, lead free bronze mounted, lead free bronze shaft, flanged ends, and non-asbestos composition packing, and two-piece backing gland assembly.

2.6 CHECK VALVES

- A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.
- B. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Install valves in accordance with manufacturer's installation instructions.
- B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:

- H. Swing Check Valves: Horizontal position with hinge pin level.
- I. Lift Check Valve: With stem upright and plumb.

3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
 2. Copper Tube Sizes 2-1/2 Inch and Larger: flanged end.

3.3 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

- A. Domestic Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	200
Gate	125	125
Globe	125	125
Check	125	125

- B. Domestic High Pressure Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	N/A
Gate	N/A	250

3.4 VALVE SCHEDULE

- A. Gate Valves - 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER NRS</u>
Apollo	102S-LF
Hammond	UP-668
Milwaukee	UP668
NIBCO	S-113-LF

- B. Gate Valves - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>OS&Y RS</u>	<u>NRS</u>
Apollo	611F-LFA	610F-LFA

- C. Gate Valves - 2-1/2 inch and larger – Class 250:

<u>MANUFACTURER</u>	<u>OS&Y RS</u>	<u>NRS</u>
Apollo	611F-LFA	620F-LFA

D. Ball Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>
Apollo (Conbraco)	70-LF-200
Hammond	UP8511
Milwaukee	UPBA-150
NIBCO	N/A

E. Ball Valves (full port) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-200	77C-LF-100
Hammond	UP8311A	UP8301A
Milwaukee	UPBA-450	UPBA-400
NIBCO	S-585-80-LF	T-585-80-LF

F. Ball Valves (full port – SS Ball) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-240	77C-LF-140
Hammond	UP8313A	UP8303A
Milwaukee	UPBA-450S	UPBA-400S
NIBCO	S-585-66-LF	T-585-66-LF

G. Globe Valves - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>STRAIGHT BODY</u>	<u>ANGLE BODY</u>
Apollo	711F-LFA	N/A

H. Globe Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>
Apollo	120S-LF
Hammond	UP-418
Milwaukee	UP1502
NIBCO	S113

I. Swing Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509

NIBCO S-413-Y-LF T-413-Y-LF

J. Swing Check Valves - 2-1/2 inch and larger – Class 125:

MANUFACTURER Flanged Ends

Apollo 910F-LFA

K. Swing Check Valves - 2-1/2 inch and larger – Class 250:

MANUFACTURER Flanged Ends

Apollo 920F-LFA

3.5 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Gate Valves, 2" and smaller: Class 125, with cast bronze body.
 - 2. Gate Valves, 2-1/2": Class 125 with cast-iron body.
 - 3. Ball Valves, 2" and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe..
 - 4. Ball Valves, 2-1/2" and larger: 200-psi CWP cast iron body.
 - 5. Globe Valves, 2" and smaller: Class 125, with cast bronze body and bronze or teflon disc.
 - 6. Globe Valves, 2-1/2" and larger: Class 125, with cast iron body and bronze or teflon disc.
 - 7. Swing Check, 2-1/2" and smaller: Class 125, cast bronze, with rubber seat.
 - 8. Check Valves, 2-1/2" and larger: Class 125, swing or wafer type as indicated.

3.6 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.7 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION

SECTION 15141 (220529) - HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.
- B. Horizontal-piping hangers and supports.
- C. Shields
- D. Vertical piping clamps
- E. Pipe alignment guides.
- F. Pipe anchors.
- G. Pre-engineered roof supports
- H. Anchors and fasteners.
- I. Miscellaneous materials.
- J. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
 - 2. Division 22 "Water Distribution Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
 - 3. Division 22 "Sanitary Drainage & Vent Piping and Specialties", for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 SUBMITTALS

- A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
- E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
 - 1. Application of protective inserts, and shields at pipe hangers for each type of insulation and hanger.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
 - 1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.6 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

PART 2 - PRODUCTS AND MATERIALS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
 - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
 - c. Natatorium or other treated pool environments: Type 316 stainless steel.
 - d. Outdoor Locations: Galvanized steel or type 304 stainless steel.
 - e. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
 - f. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - g. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - h. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:

1. Manufacturers:
 - a. Cooper B-Line.
 - b. Ferguson Enterprises/FNW.
 - c. PHD Manufacturing.
 - d. Thomas & Betts Corporation.
 - e. Unistrut, a brand of Atkore International Inc.
 - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-69, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.
4. Channel Material:
 - a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
 - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
 - c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
 - d. Natatorium or other treated pool environments: Type 316 stainless steel.
 - e. All nuts, brackets, and clamps shall have the same finish as the channel.
5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

- C. Hanger Rods:
1. Material:
 - a. Indoor Dry Locations: Zinc-plated steel.
 - b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
 - c. Natatorium or other treated pool environments: Type 316 stainless steel.
 2. Threaded both ends or continuously threaded.
 3. Minimum Size: Reference piping specification sections for rod thicknesses.
 4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.
- D. Wire Rope Pipe Hanging Systems:
1. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Gripple.
 2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
 3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
 4. Cast-in-place Concrete Insert: Pressed steel body with sintered steel wedge, 302 stainless steel spring and UV stabilized homopolymer polypropylene end cap. Model: Gripple Spider Hanging Kit.
 5. Cable Stud: Carbon steel, zinc-coated, designed for attachment to concrete inserts. Model: ASC Engineered SolutionsC120.
 6. Cable Coupling: Carbon steel, zinc-coated, designed for attachment to threaded rods. Model: ASC Engineered SolutionsC130.
 7. Cable Eyelet: Carbon steel, zinc-coated, designed to be directly attached to structural supports via anchors or fasteners. Model: ASC Engineered SolutionsC150.
 8. Cable Toggle: Carbon steel, zinc-coated, with toggle designed for insertion into 1/2 inch hole through steel deck hat channel and provides anchor when pulled in tension. Model: ASC Engineered SolutionsC160.
 9. Swivel Toggle Insert: Single assembly attached to wire rope cable, manufactured from plated carbon steel toggle, pins, and shackles; swivel insert engineered to be compatible with concrete insert.
 10. Wire Rope: High tensile steel wire rope, to ASTM A1023, Class A zinc coating; minimum 7 by 7 cross-sectional thread construction; having a tensile strength of 256,000 psi; No.3 wire size minimum.
 11. Adjustable Fastener: Mild steel (type UG2), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 500 lb. Model: Gripple No. 2, 3 or 4 UniGrip.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. MANUFACTURERS
1. ASC Engineered Solutions.
 2. Cooper B-Line, Inc.
 3. Elite Components
 4. ERICO/Michigan Hanger Co./Caddy
 5. Ferguson/FNW.
 6. Halfen-DEHA.
 7. Hilti.
 8. National Pipe Hanger Corporation.

9. PHD Manufacturing.
 10. Power-Strut.
 11. Unistrut.
- B. Single Hangers:
1. Split Ring: Carbon steel, adjustable swivel, split ring type.
 2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
 3. Clevis Hanger: Carbon steel, adjustable, clevis type.
 4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.
- C. Trapeze and Strut-mounted Supports:
1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
 2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.
- D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Holdrite.
 - c. Klo-Shure.
 2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.
- E. Spring Hangers:
1. Reference Section “Vibration Isolation for Plumbing Piping and Equipment” for spring isolation hangers.
- F. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
 2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.
- G. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- H. Pre-Insulated Supports:
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell.
 - c. Buckaroos, Inc.
 - d. Cooper B-Line, Inc.
 - e. Pipe Shields, Inc.
 2. General Construction and Requirements:
 - a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
 - b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Waterproof calcium silicate insulation shall conform to ASTM C795.

- d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
- e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
- 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.3 SHIELDS

A. Insulation Protection Shield:

- 1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2” inside dimension and smaller, 16 gauge for 6-1/2” to 10-3/4” inside dimension 14 gauge for 11-3/4” to 17” inside dimension, and 12 gauge for 18” to 28” inside dimension.
- 2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
- 3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support. .
- 4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in)					
		Hanger Spacing, (ft)					
		5	6	7	8	9	10
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
≤ 2	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

- B. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

C. Plastic Shields:

- 1. Manufacturers:
 - a. Armacell.
 - b. Eaton.
 - c. Hydra-Zorb.
 - d. PHD Manufacturing.
 - e. Zsi Foster.
- 2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.4 VERTICAL-PIPING SUPPORTS

A. Manufacturers:

- 1. ASC Engineered Solutions.
- 2. Cooper B-Line, Inc.
- 3. Halfen-DEHA.
- 4. Hilti.
- 5. ERICO/Michigan Hanger Co.
- 6. National Pipe Hanger Corporation.
- 7. PHD Manufacturing.

- 8. Power-Strut.
 - 9. Unistrut.
- B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
- 1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
 - 2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
 - 3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.
- C. Riser Clamps with pre-manufactured polymer insert:
- 1. Manufacturers:
 - a. Hydra-Zorb; Titan Riser Clamp.
 - b. National Pipe Hanger.
 - c. Pipe Hangers, Inc.
- D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.5 PIPE ALIGNMENT GUIDES

- A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.
- 1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
 - 2. Pipe Diameter 10 inches and Larger: Roller type.
 - 3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

2.6 PIPE ANCHORS

- A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.
- B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

2.7 PRE-ENGINEERED ROOF PIPE SUPPORTS

- A. Manufacturers:
- 1. Airtec.
 - 2. ASC Engineered Solutions.
 - 3. Cooper B-Line, Inc.
 - 4. Elite Components.
 - 5. ERICO/Michigan Hanger Co./Caddy.
 - 6. Ferguson/FNW.
 - 7. Miro.
 - 8. PHP Systems/Design.
 - 9. PHD Manufacturing.
 - 10. Roof Top Blox.

11. Unistrut, a brand of Atkore International Inc.
12. Zsi Foster.

B. General: Pre-engineered devices with embedded pipe support fixtures as specified.

C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:

1. Up to 12 inch strut length support: 18 inch x 18 inch.
2. Up to 16 inch strut length support: 24 inch x 18 inch.
3. Up to 24 inch strut length support: 30 inch x 18 inch.
4. Thickness: Minimum 3/16 inch thick.

D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.

1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
2. Width: Nominal 4 inches.

E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.8 ANCHORS AND FASTENERS

A. Manufacturers:

1. Hilti, Inc.
2. Illinois Tool Works, Inc.
3. Phillips.
4. Powers Fasteners, Inc.
5. Rawl.
6. Simpson Strong-Tie Company Inc.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

1. Concrete: Use preset concrete inserts or expansion anchors.
2. Solid or Grout-Filled Masonry: Use expansion anchors.
3. Hollow Masonry: Use toggle bolts.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.

E. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

1. Comply with MFMA-4.
2. Channel Material: Use galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
5. Manufacturers:
 - a. Same as manufacturer of metal channel (strut) framing system.

b. DeWalt “Bang-It” concrete inserts.

F. Post-Installed Concrete and Masonry Expansion Anchors:

1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.

G. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.

1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

H. Vibration Isolation Anchors: Reference Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment” for vibration isolation anchors.

2.9 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Malleable Iron: ASTM A47

I. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION, GENERAL

- A. Install hangers and supports in accordance with manufacturer’s installation instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 22 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
 - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
 - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 - 4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.
- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.
 - 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
 - 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- I. Install building attachments within concrete or to structural steel.
 - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
 - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- K. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
 - a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.
 2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.
 - a. Exception for horizontal cold-piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.
 3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
 4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- P. Vertical Piping Risers:
1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.
- Q. Wire Rope Hanging Systems:
1. Install in accordance with manufacturer's instructions.
 2. Supported load shall not exceed manufacturer's recommended load rating.
 3. Applications for Pipe Supports:
 - a. 3 inch and smaller.
 - b. Wire rope hanging system is not allowed for steam or steam condensate piping.
 4. Do not support pipe by wrapping the rope around the pipe.
 5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in Division 22 piping sections.
 6. Install cast-in-place concrete inserts in elevated concrete slabs.
 7. Install bream clamps for attachment to structural beams as required.
- R. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.
- S. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and

torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise. Install pipe insulation at guide to not interfere with movement of pipe within the guide.

- B. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.
- C. Anchor to building substrate.

3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

3.6 EQUIPMENT SUPPORTS

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- I. Grouting: Place grout under supports for piping and equipment.

3.7 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.8 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- E. Correct deficiencies and replace damaged or defective support and attachment components.

3.9 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Single Hangers:
 - 1. All pipe sizes 1-1/2 inch and less:
 - a. Band hanger.
 - b. Swivel split ring.
 - c. Clevis hanger.
 - 2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
 - 3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
 - 4. All drainage pipe sizes: Clevis hanger.
- D. Trapezes and Strut-mounted Supports:
 - 1. All pipe sizes less than 6 inches: Two-piece clamp.
 - 2. Pipe sizes 6 inches and greater: Roll support.
- E. Wall Supports:
 - 1. Pipe sizes 3 inches and less:
 - a. Two-hole strap mounted to wall.
 - b. Welded steel bracket with reinforced angle or strut.
 - 2. Pipe sizes 4 inch and greater:
 - c. U-bolt
 - d. Welded steel bracket with reinforced angle or strut.
- F. Floor Supports:
 - 1. Pipe sizes 4 inch and less: Pipe saddle.
 - 2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION

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SECTION 15445 (220548) - SEISMIC CONTROLS FOR PLUMBING SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 20 Section "Seismic Controls for MEP/F/T Systems" for general requirement and related documents that apply to this section.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 SUMMARY

- A. Seismic bracing, restraints, and controls for all plumbing systems specified herein shall be designed and installed as required by Division 20 Section "Seismic Controls for MEP/F/T Systems".

1.5 SUBMITTALS

- A. Provide submittals as required by Division 20 Section "Seismic Controls for MEP/F/T Systems" for all plumbing systems specified herein.

PART 2 - PRODUCTS AND MATERIALS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

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SECTION 15201 (220550) - VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. It is the intent of this specification to provide vibration isolation supports for Plumbing equipment as scheduled at the end of this Section.
- B. This work shall include all materials and labor required for the installation of the vibration isolation devices.
- C. Vibration isolators shall be selected by the weight distribution to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule included at the end of this Section.
- D. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.
- E. All vibration isolation devices shall be treated for corrosion resistance using galvanization for exterior applications and painting for interior applications.
- F. Related Sections:
 - 1. Division 22 Section "Common Work Results for Plumbing" for materials and methods for concrete equipment pads.
 - 2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for flexible connectors.
 - 3. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hangers and supports.
 - 4. Division 22 Section "Domestic Booster Pumps," for materials and methods for domestic booster pumps.
 - 5. Division 22 Section "Gas and Vacuum Systems for Health Care Facilities" for materials and methods for medical air compressors and vacuum pumps.
 - 6. Division 22 Section "Gas and Vacuum Systems for Laboratories" for materials and methods for laboratory air compressors and vacuum pumps.
 - 7. Division 22 Section "General Service Compressed Air Systems" for materials and methods for air compressors.

1.2 WORK INCLUDED

- A. Provide complete vibration isolation systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:
 - 1. Foundations, vibration isolation, and supports for rigidly supported equipment.
 - 2. Vibration Isolation

1.3 RELATED WORK SPECIFIED ELSEWHERE

1.4 CONTRACTOR'S RESPONSIBILITY

- A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to

meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be provided by the Contractor without claim for additional payment.

- B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly to the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.5 MANUFACTURER'S RESPONSIBILITIES

- A. Manufacturer of vibration isolation equipment shall have the following responsibilities:
 1. Determine vibration isolation for all equipment and systems in accordance with the local governing code.
 2. Provide piping and equipment isolation systems as scheduled or specified.
 3. Guarantee specified isolation system deflection.
 4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
 5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
 6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

1.6 SUBMITTALS

- A. Submittal data shall show type, size, and deflection of each isolator proposed. Include clearly outlined procedures for installing and adjusting the isolators.
- B. Submit a vibration isolation system schedule indicating the following:
 1. Manufacturer, type, model number, size
 2. Height when uncompressed and static deflection of each isolation element
 3. Spring constant of each isolation element
 4. Estimated imposed load on each isolation element
 5. Spring o.d., free operating, and solid heights
 6. Design of supplementary bases.
 7. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing.
 8. Piping isolators shown and identified on piping layout drawings.
 9. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of the Contractor's equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, etc.

1.7 QUALITY ASSURANCE

- A. It is the objective of this Specification to provide for the control of vibration due to the operation of machinery or equipment, and/or due to interconnected piping or conduit.

- B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. All vibration isolation equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:
 1. Amber Booth.
 2. Kinetics Noise Control.
 3. Mason Industries, Inc.
 4. Vibration Eliminator Co., Inc.
 5. Vibration Mounting and Controls.

2.2 GENERAL

- A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

2.3 VIBRATION ISOLATORS

A. GENERAL

1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The isolator schedule shall take precedence.
2. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
3. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, the amount of deflection can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
4. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
5. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\pm 10\%$.
6. All neoprene mountings shall have a Shore hardness of 30 to 60 ± 5 , or as specified herein, after minimum aging of 20 days or corresponding over-aging.
7. Housed or caged spring isolators are not acceptable.
8. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

B. ISOLATOR TYPE WP

1. Type WP (Waffle Pads) shall be 5/16 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality neoprene, and selected for a maximum

durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.

2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type WP: Mason Industries Type W or as approved.)

C. ISOLATOR TYPE MWP

1. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 inch thick ribbed or waffle neoprene pads sandwiching a 16 gauge stainless steel shim plate. The pad shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type MWP: Mason Industries Type WSW or as approved.)

D. ISOLATOR TYPE DDNM

1. Type DDNM (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
3. (Type DDNM: Mason Industries Type ND or as approved.)

E. ISOLATOR TYPE DDNH

1. Type DDNH (Double Deflection Neoprene Hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches.
3. (Type DDNH: Mason Industries Type HD or as approved.)

F. ISOLATOR TYPE SPNM

1. Type SPNM (Spring and Neoprene Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
2. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 inch, and the minimum static deflection for equipment mounted above grade level shall be 2 inches.
3. Two Type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
5. (Type SPNM: Mason Industries Type SLFH or as approved.)

G. ISOLATOR TYPE SPNH

1. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches.
3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
4. (Type SPNH: Mason Industries Type 30N or as approved.)

H. BASE TYPE CIB

1. Inertia base Type CIB (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured.
2. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
3. When the concrete base is "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
4. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
5. (Base Type CIB: Mason Industries Type KSL or as approved)

I. NEOPRENE MOUNTING SLEEVES

1. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

J. PIPE FLEXIBLE CONNECTORS

1. Refer to Section "Basic Piping Materials and Methods" for requirements for flexible pipe connectors.

PART 3 - EXECUTION

3.1 GENERAL

- A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.
- B. All floor-mounted equipment shall be erected on concrete equipment pads over the complete floor area of the equipment, unless otherwise specified herein. Refer to Section "Basic Piping Materials and Methods" for concrete equipment pad requirements. These pads shall be integrally keyed to structural slab. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted on concrete equipment pads unless otherwise specified herein.
- C. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.
- D. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 1/4" maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.

- E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete equipment pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short-circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.
- F. Piping or plumbing equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.
- G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.
- H. All plumbing equipment not specifically identified in this specification that contains rotating or vibrating elements, and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM neoprene isolators as appropriate.
- I. All wiring connections to plumbing equipment on isolators shall be made with a minimum 18 inch long flexible conduit in a "U" shaped loop.
- J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.
- K. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
- L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- M. Refer to Vibration Isolation Schedule at the end of this Section.

3.2 DOMESTIC BOOSTER PUMPS

- A. Packaged domestic booster pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.
- B. Packaged domestic booster pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to a spring supported concrete inertia base and be provided with vibration isolators as scheduled in the table at the end of this section. Provide concrete inertia base with thickness as scheduled in the table at the end of this section and provide with a 2" minimum operating clearance between the base and equipment pads.

3.3 AIR COMPRESSORS AND VACUUM PUMPS

- A. Base-mounted air compressors and vacuum pumps shall be bolted and grouted to Base Type CIB with the inertia base supported on Type SPNM isolators as scheduled in the table at the end of this section.
- B. Packaged air compressors and vacuum pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

- C. Packaged air compressors and vacuum pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to Base Type CIB with the inertia base and be provided with vibration isolators as scheduled in the table at the end of this section.
- D. Tank mounted air compressors and vacuum pumps installed on slab on grade shall be bolted and grouted to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.
- E. Tank mounted compressors and vacuum pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to Base Type CIB with the inertia base and be provided with vibration isolators as scheduled in the table at the end of this section.

3.4 SUPPORT OF PIPING

- A. The following water and condensate piping shall be resiliently supported:
 1. Piping within 50 feet of connected rotating equipment.
 2. Piping installed below or adjacent to noise sensitive areas.
- B. Pipes connected to equipment installed on spring vibration isolators shall be suspended or supported by Type SPNM or Type SPNH isolators. Provide vibration isolation anchors and guides as specified elsewhere in this section. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.
- C. Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.
- D. Where a pipe run connects multiple items of equipment in the mechanical room the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.
- E. Resilient diagonal mountings or other approved devices shall be provided as required to limit piping motion due to equipment startup or shut down, to a maximum of 1/8".
- F. Water piping hanger rod isolators shall contain a steel spring in series with a 1/4" acoustical neoprene pad within a steel box retainer. The hanger rod isolator assembly shall be rigidly supported from the spring sub-assembly and shall not contact the steel box retainer. Clearances in the isolator design shall be capable of accepting a 15 degree misalignment in any direction from the vertical.
- G. The steel spring element of the assembly shall be designed to have a minimum surge frequency of 340 HZ and a minimum deflection of 3/4".
- H. Hanger rod isolators for steam and condensate piping including steam pressure reducing valve stations shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".
- I. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08" and shall be resiliently supported from the building structure with mountings as described above. Supported piping from the supplementary steel shall be rigidly suspended or supported.
- J. Pre-compressed type hanger rod isolators shall be provided for all water piping greater than 12" diameter and all supplementary steel supports. The pre-compression shall be factory set at 75% of rated deflection.
- K. Where isolated water piping 8" and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of

the beam. For piping 6" and smaller, beam clamps may be used in lieu of welding subject to approval of beam clamp selection.

3.5 PIPING ANCHORS, GUIDES AND SUPPORTS

- A. General: Pipe riser guides, anchors and supports including piping anchors in mechanical equipment rooms or occupied spaces shall be isolated from the building structure such that there shall be no direct metal to metal contact of the piping with the building structure.
- B. Piping Anchors and Guides
 - 1. The all directional pipe anchor isolation mountings shall consist of a telescoping arrangement of two sizes of steel tubing separated by a minimum of 1/2" thick heavy duty neoprene and canvas duct isolation pad. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. The allowable load on the isolation material shall not exceed 500 psi.
 - 2. Steel guides shall be welded to the pipe at a maximum spacing of 90°. The outside diameter of the opposing guide bars shall be smaller than the inside diameter of the pipe riser clamp in accordance with standard field construction practice. Each end of the pipe guide shall be rigidly attached to an all directional pipe anchor isolation mounting which in turn, shall be rigidly fastened to the steel framing within the shaft.
 - 3. Low temperature piping guides shall be constructed with a 360 degree 10 gauge metal sleeve around the piping. The thermal insulation requirements for the piping shall be provided between the piping and the sleeve. Heavy duty neoprene and canvas duct isolation pad of thickness equal to thermal insulation requirements shall space the metal sleeve away from the piping with urethane or other suitable thermal insulation provided in the voids between the pipe-sleeve and isolation pan material. The metal sleeve outside diameter shall be smaller than the pipe riser clamp inside diameter in accordance with standard field construction practice. The pipe riser clamp shall be rigidly attached to the steel framing within the shaft.
- C. Piping Supports:
 - 1. Piping supports within shafts shall be provided with suitable bearing plates and two layers 1/4" thick ribbed or waffled neoprene pad loaded for 50 psi maximum. The isolation pads shall be separated with 1/4" steel plate. The isolation pads shall be Type WP or approved equal.
 - 2. Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy duty neoprene and canvas duct isolation pad separated by 1/4" thick steel plate. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with resilient sleeves and washers. All pipe support resilient materials shall be HL Mason Industries, Inc., or as approved.

3.6 FLEXIBLE PIPING CONNECTORS

- A. Flexible piping connectors shall be installed to connect piping diameter 2" or greater to reciprocating or rotating equipment.

3.7 PIPE RISER SUPPORTS

- A. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.
- B. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators and central anchors designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch

locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.

3.8 WIRING

- A. All wiring connections to plumbing equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 18 inch long flexible conduit in a “U” shaped loop. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.9 FIELD QUALITY

- A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

3.10 ADJUSTMENT AND TESTING

- A. Site Access: During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and the Contractor’s representatives.
- B. Contractor’s Vibration Isolation Report: The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Architect which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.
- C. Consultant’s Inspection: Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by the vibration isolation report.

3.11 GUARANTEE

- A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

3.12 SCHEDULE OF VIBRATION ISOLATORS

EQUIPMENT	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
Base-mounted pumps (less than 50 HP) (Slab-On-Grade)	Equipment Pad		
Base-mounted pumps (50 HP or greater) (Slab-On-Grade)	Inertia Base CIB	SPNM	0.75"
Base-mounted pumps (3 hp or greater) (Suspended Slab)	Inertia Base CIB	SPNM	2"
Base-mounted pumps (less than 3 hp) (Suspended Slab)	Equipment Pad	DDNM	.4"
In-Line Pumps ½ HP & Larger		SPNH	1.75"
Domestic Booster Pumps (Slab on Grade)	Equipment Pad	MWP	0.25
Domestic Booster Pumps (Suspended Slab)	Inertia Base CIB	SPNM	2"
Air Compressors and Vacuum Pumps (Tank Mtd.) (Slab on Grade)	Equipment Pad	MWP	0.25"
Air Compressors and Vacuum Pumps (Tank Mtd.) (Suspended Slab)	Equipment Pad	SPNM	0.75"
Air Compressors and Vacuum Pumps (Packaged) (Slab on Grade)	Equipment Pad	MWP	0.25"
Air Compressors and Vacuum Pumps (Packaged) (Suspended Slab)	Inertia Base CIB	SPNM	0.75"
Air Compressors and Vacuum Pumps (Base Mtd)	Inertia Base CIB	SPNM	0.75"
Piping		Isolation as per specification.	

END OF SECTION

SECTION 15191 (220553) - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.
- B. Types of identification devices specified in this Section include the following:
 - 1. Painted Identification Materials
 - 2. Plastic Pipe Markers
 - 3. Plastic Tape
 - 4. Underground-Type Plastic Line Marker
 - 5. Valve Tags
 - 6. Valve Schedule Frames
 - 7. Engraved Plastic-Laminate Signs
 - 8. Plastic Equipment Markers
 - 9. Plasticized Tags

1.2 CODES AND STANDARDS:

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
- D. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section "General Plumbing Requirements."

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Industrial Safety Supply Co., Inc.
 - 4. Seton Name Plate Corp.

2.2 PLUMBING IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1-1/4" high letters for ductwork and 3/4" high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Stencil paint shall be exterior type, oil based, alkyd enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Identification paint shall be oil based, alkyd enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- G. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.

- H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

2.5 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKER

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
 - 2. Fill tag engraving with black enamel.
- B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
- C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/8" sq. white tags with black lettering.
- D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.8 ACCESS PANEL MARKERS

- A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.9 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.10 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for plumbing fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.11 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
 - 1. Green: Cooling equipment and components.
 - 2. Yellow: Heating equipment and components.
 - 3. Yellow/Green: Combination cooling and heating equipment and components.
 - 4. Brown: Energy reclamation equipment and components.
 - 5. Blue: Equipment and components that do not meet any of the above criteria.
 - 6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1. Name and plan number.
 - 2. Equipment service.
 - 3. Design capacity.
 - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.12 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.13 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
 - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Application: Provide piping system identification for the following systems:
 - 1. Domestic cold water piping.
 - 2. Domestic hot water piping.
 - 3. Domestic hot water recirculating piping.
 - 4. Non potable water piping
 - 5. Lawn irrigation piping.
 - 6. Sanitary and waste piping.
 - 7. Storm water piping.
 - 8. Vent piping.
 - 9. Insulated and non-insulated storm water piping.
 - 10. Compressed air piping.
 - 11. Natural gas piping.
- C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - 1. Within 5 feet of each valve and control device.
 - 2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
 - 3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
 - 4. At access doors, manholes and similar access points which permit view of concealed piping.
 - 5. Within 5 feet of major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

3.3 UNDERGROUND PIPING IDENTIFICATION

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-

watering hose bibbs, and shut-off valves at plumbing fixtures and similar rough-in connections of end-use fixtures and units.

- B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
 - 1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.5 PLUMBING EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gauges, thermometers and similar units.
 - 3. Pumps
 - 4. Heat exchangers
 - 5. Water heaters, tanks and pressure vessels.
 - 6. Strainers, water treatment systems and similar equipment.
- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.
- C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
 - 2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION

SECTION 15251 (220700) - PLUMBING INSULATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of Plumbing insulation required by this Section is indicated on drawings and schedules, and by requirements of this Section.
- B. Types of Plumbing insulation specified in this Section include the following:
 - 1. Piping Systems Insulation:
 - a. Fiberglass
 - b. Flexible Elastomeric
 - 2. Equipment Insulation:
 - a. Fiberglass
 - b. Flexible Elastomeric

1.2 QUALITY ASSURANCE

- A. Flame/Smoke Ratings: Provide composite Plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor Plumbing insulation may have flame spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial Plumbing insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields for protecting insulation vapor barrier and materials and methods for piping installations.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each Plumbing system requiring insulation.
- B. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. CertainTeed Corp.
 - 2. Knauf Insulation
 - 3. Johns Manville
 - 4. Owens Corning

2.2 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.
- B. Flexible Elastomeric Piping Insulation: ASTM C534, Type I.
- C. Jackets for Piping Insulation: ASTM C1136, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
 - 1. PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, Johns Manville Zeston 2000 PVC or approved equivalent. Factory supplied, pre-cut insulation blanket inserts for use with PVC fitting covers are acceptable.
- D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
- F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- H. High Density Insulation Billets:
 - 1. Cellular Glass: ASTM C552.

2.3 EQUIPMENT INSULATION MATERIALS

- A. Rigid Fiberglass Equipment Insulation: ASTM C612, Class 2.
- B. Flexible Fiberglass Equipment Insulation: ASTM C553, Type I, Class B-4.
- C. Flexible Elastomeric Equipment Insulation: ASTM C534, TYPE II.
- D. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.
- E. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- F. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's installation instructions.

3.2 PLUMBING PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on the following:
 - 1. Chrome-plated exposed piping
 - 2. Water Hammer Arrestors

3. Balancing and flow valves
4. Drain lines from water coolers
5. Exterior condensate drain piping
6. Buried piping
7. Pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:
 - a. Potable cold water piping.
 - b. Non-potable cold water piping
 - c. Plumbing vents within 6 lineal feet of roof outlet.
 - d. Condensate piping inside the building.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1" thickness.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:
 - a. Potable hot water piping.
 - b. Potable hot water recirculation piping.
 - c. Hot drain piping (where indicated).
2. Insulate hot water piping systems up to 140F specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1" thick for pipe sizes up to and including 3/4", 1-1/2" thick for pipe sizes 1" and larger.
 - b. Calcium Silicate: 1-1/2" thick for pipe sizes up to and including 3/4", 2-1/2" thick for pipe sizes 1" and larger.

D. P-traps:

1. Insulate P-traps receiving chilled water waste and P-traps of water coolers as described below:
 - a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2" to 6" (largest size permitted).
2. Insulate P-traps receiving hot water waste above 140F as described below:
 - a. Fiberglass: 1" thickness.
 - b. Flexible Elastomeric (high temp formula up to 300F): 1" thickness.

E. Piping Inside Masonry Wall Units:

1. Insulate cold, hot and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:
 - a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2" to 6" (largest size permitted).

F. Exterior piping:

1. Encase exterior piping insulation with aluminum weather-proof jackets.
2. Insulate exterior cold water, hot water, hot water recirculation and non-potable water piping as previously described.
3. Insulate and heat trace exterior [sanitary p-traps,] [sanitary,] [grease waste,] [storm,] and [overflow storm] piping as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
 - a. Fiberglass: 1" thickness.
 - b. Flexible Elastomeric: 1" thickness.

G. Interior piping with heat trace:

1. Insulate and heat trace grease waste piping and grease waste P-traps as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.
 - a. Fiberglass: 2" thickness.
 - b. Flexible Elastomeric: 2" thickness.

3.3 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.
- C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- E. Clean and dry pipe surfaces prior to insulating.
 - 1.
- F. Pipe insulation:
 1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
 2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
 3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers & Supports for Plumbing Piping" for insulation shields.
 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 5. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints.
 6. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
 7. For cold pipes, apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- G. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves (except balancing and flow control valves), strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Butt tightly against adjoining pieces and bond with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control valves), flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- H. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- I. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- J. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.4 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breechings, or stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

3.5 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 15411 (221100) - WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.

- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
 - 3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 4. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
 - 5. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
 - 6. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
 - 7. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
 - 8. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
 - 9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
 - 10. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties," for material and methods for trap primer outlet piping.

- C. Products installed but not furnished under this Section include water meters that will be provided by the utility company to the site and ready for installation. Following is the name and address of the utility company:

1.2 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.

- C. Pipe sizes used in this Specification are nominal pipe size (NPS).

- D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
 - 1. Product data for each piping specialty and valve specified.
 - 2. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
 - 3. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
 - a. Hose bibbs
 - b. Wall, yard, and roof hydrants
 - c. Backflow preventers isolating irrigation or mechanical make-up systems
 - d. Emergency mixing valves
 - e. Trap primers

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following codes:
- B. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- C. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.5 SPARE PARTS

- A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Automatic Flow Control Valves:
 - a. Calefi
 - b. Flow Design, Inc., Autoflow Div.
 - c. Victaulic Company
 - 2. Hose Bibbs with Vacuum Breaker:
 - a. Chicago Faucet Co.
 - b. Eljer, A Household International Company
 - c. T & S Brass & Bronze Works, Inc.
 - 3. Hose Bibbs:
 - a. Lee Brass Co.
 - b. Mansfield Plumbing Products
 - c. Mifab Manufacturing, Inc.
 - d. Nibco, Inc.
 - e. Prier, Inc.

- f. Watts Regulator Co.
- g. Woodford Mfg. Co.
- 4. Wall/Yard Hydrants:
 - a. Josam Co.
 - b. Mifab Manufacturing, Inc.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Prier, Inc.
 - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Drainage
 - g. Woodford Mfg. Co.
 - h. Zurn Industries Inc., Hydromechanics Div.
- 5. Backflow Preventers:
 - a. Cla-Val Co.
 - b. Conbraco Industries, Inc.
 - c. Febco
 - d. Hersey Products, Inc.
 - e. Mifab Manufacturing, Inc./Beeco
 - f. Watts Regulator Co.
 - g. Zurn Industries Inc. Wilkins Regulator Div.
- 6. Relief Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Conbraco Industries, Inc.
 - c. Watts Regulator Co.
 - d. Zurn Industries, Inc. Wilkins Regulator Div.
- 7. Piston Type Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Josam Co.
 - c. Precision Plumbing Products, Inc.
 - d. PROFLO
 - e. Sioux Chief Manufacturing Co.
 - f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - g. Watts Regulator Co.
 - h. Zurn Industries, Inc. Wilkins Regulator Div.
- 8. Point of Use Thermostatic Mixing Valves
 - a. Acorn Engineering Co.
 - b. Cash Acme
 - c. Leonard Valve Co.
 - d. Powers Process Controls
- 9. Emergency Mixing Valves
 - a. Acorn Engineering Co.
 - b. Bradley
 - c. Haws Corp.
 - d. Lawler Manufacturing Co., Inc.
 - e. Leonard Valve Co.
 - f. Stingray Systems
- 10. Trap Primers and Distribution Units
 - a. Mifab Manufacturing, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. PROFLO
 - d. Sioux Chief
- 11. Plumbing Pipe Support Brackets
 - a. Holdrite
 - b. PROFLO
 - c. Sioux Chief
- 12. Sanitary Roof Hydrants
 - a. Hoepfner Perfected Products

- b. Jay R. Smith Mtg Co.
- c. Mapa
- d. Woodford Mfg. Co.

2.2 PIPE AND TUBE MATERIALS, GENERAL

- A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or "Below Ground Water Distribution Pipe and Fittings", for identification of systems where the materials listed below are used.
- B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.
- C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.
- D. PVC Plastic Service Pipe: AWWA C900, Class 100 Polyvinyl Chloride (PVC) water pipe, with belled-end fittings.
- E. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.3 FITTINGS

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Galvanized Malleable Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.
- C. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.
- D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.
- E. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.
- F. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

2.4 JOINING MATERIALS

- A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.
- B. Brazing Filler Metals: AWS A5.8, BAg Silver.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.5 GENERAL-DUTY VALVES

- A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.6 SPECIAL DUTY VALVES

- A. Automatic Flow Control Valves: 400 PSI WOG, flow regulator, with series 300 stainless steel body, series 300 stainless steel automatic pre-set flow balancing cartridge, union connection body, and threaded-end connections.

2.7 PIPING SPECIALTIES

- A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
- B. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- C. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
- D. Roof Hydrants: As specified on the drawings.
- E. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.
- F. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
 - 1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.
- G. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- H. Point of Use Thermostatic Mixing Valves:
 - 1. Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.
- I. Emergency Mixing Valves:
 - 1. Bronze body construction meeting ASTM B584, non-corrosive parts, tamper resistant temperature adjustment, union inlets. Valve shall be designed to fail to the cold side of the system with full cold water flow. Maximum pressure drop shall not be exceeded for the scheduled flow rate.
- J. Trap Primers: Brass construction, line pressure operation, capacity to prime number of traps as indicated with distribution units complying with requirements of ASSE Standard 1018.
- K. Pipe Support Brackets:
 - 1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
 - 2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
 - 3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

- A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. PVC Service Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to prevent pipe deflection and then install subbase. Refer to Section “General Plumbing Requirements” for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 “Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications” for additional requirements.
- B. Copper Tube: Provide 6” thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section “General Plumbing Requirements” for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.
- B. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.
- C. Install ductile or gray-iron epoxy coated fittings for 3” and larger at water service entrance riser and only upstream of the backflow preventer.

3.4 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.
- B. Install AWWA C900 PVC service pipe with belled-end joints from 5’-0” outside the building.

3.5 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation

applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.

3.6 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
 - 1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Supports and Anchors" and "Plumbing Insulation".
 - 4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
 - a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
 - 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
 - 6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
 - 7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
 - 8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.

9. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.
 - a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
 - b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
 10. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size - In.</u>	<u>Steel Pipe Max. Span - Ft.</u>	<u>Copper Tube Max. Span - Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8

1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
 2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
- D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.
- E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.7 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
 2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 3. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

- D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Provide dielectric waterway fittings for 2" and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section "Basic Piping Materials and Methods".
- F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.8 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shut-off duty: Use gate, ball, and butterfly valves.
 2. Throttling duty: Use globe, ball, and butterfly valves.

3.9 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.
- F. Wall Hydrants: Install where indicated with vacuum breaker.
- G. Emergency Mixing Valves: Install where indicated on the plans with hot and cold water branch lines connecting to the mains without any shutoff valves. No other fixtures shall connect to the branch lines feeding the emergency mixing valve. Install ball valves with locking handles at the emergency mixing valve as indicated on the plans.
- H. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet."

3.10 INSTALLATION OF FLOW CONTROL VALVES

- A. Install automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.
- B. Set flow control valve flow rate as follows:
 - 1. Preliminary Procedures For Hot Water Return System Balancing:
 - a. Before operating the system perform these steps:
 - 1) Open valves at recirculation pump and flow control valves to full open position.
 - 2) Remove and clean all strainers.
 - 3) Check recirculation pump rotation.
 - 4) Set water heater temperature as indicated on the drawings.
 - 2. Procedures For Hot Water Return System Balancing
 - a. Refer to the drawings for required flow rate for each flow control valve.
 - b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
 - c. Apply instrument as recommended by the manufacturer.
 - d. Take readings with the eye at the level of the indicated value to prevent parallax.
 - e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
 - f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
 - a. Valve tag number and description of location
 - b. Valve body size
 - c. Differential pressure reading from instrument in psi
 - d. Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

3.11 TRAP PRIMERS

- A. Install trap primers where indicated and where required by local authorities having jurisdiction.
- B. Connect trap primer supply line to the top of domestic cold water line no larger than 1-1/2" in diameter.
- C. Provide trap primer distribution units for trap primers serving more than one trap.
- D. Install trap primer distribution level to insure even water distribution unit to each circuit.
- E. Where applicable, adjust the trap primer for proper flow.
- F. Install trap primers a minimum of 12 inches above finished floor for every 20 feet of horizontal outlet piping to floor drains served.
- G. Install trap primers in an accessible location.
- H. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for trap primer outlet pipe requirements.

3.12 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.
- B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.13 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

3.14 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
 - d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 - 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
 - 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.15 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not proscribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.16 COMMISSIONING

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
 1. Close drain valve, hydrants, and hose bibbs.
 2. Open valves to full open position.
 3. Remove and clean strainers.
 4. Check pumps for proper direction of rotation. Correct improper wiring.
 5. Lubricate pump motors and bearings.

END OF SECTION

SECTION 15412 (221123) - DOMESTIC WATER PUMPS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes the following types of plumbing pumps:
 - 1. Packaged domestic booster pumps
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
 - 2. Division 22 Section, "Basic Piping Materials and Methods" for rubber flexible connectors.
 - 3. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
 - 4. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 - 5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
 - 2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
 - 3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
 - 4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
 - 5. Submit certification that pumps, valves, fittings and specialties comply with NSF 61 Annex G.

1.3 QUALITY ASSURANCE

- A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."
- D. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A "Control Panels".
- E. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- G. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in

dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

- H. Comply with NSF 61 Annex G (pending) for wetted surfaces of valves, fittings and specialties containing no more than 0.25% lead by weight compliance for valves for domestic water service.
- I. Valves, pumps and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

1.4 SPARE PARTS

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal for each pump.

1.5 WARRANTY

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
 - 1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Packaged Domestic Booster Pumps – Variable Speed Multistage
 - a. Armstrong
 - b. Bell & Gossett, ITT
 - c. Canariss Corp.
 - d. Delta P Carver
 - e. Grundfos Pumps, Corp.
 - f. QuantumFlo, Inc.
 - 2. Aquastats:
 - a. Dayton
 - b. Honeywell
 - c. Penn
 - d. White-Rodgers

2.2 PUMPS, GENERAL

- A. Pumps and circulators: factory assembled and factory tested.
- B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are nonoverloading within the full range of the pump performance curve.

- D. Apply factory finish paint to assembled, tested units prior to shipping.

2.3 PACKAGED DOMESTIC BOOSTER PUMPS – VARIABLE SPEED MULTISTAGE

- A. Packaged, constant pressure type with triplex vertical multiple stage centrifugal pumps, control panel, motors, variable frequency drives, gauges, ball type isolation valves, dielectric isolators, remote accumulator tank, thermal bleed aquastat and solenoid valve and accessories. The packaged system, including all items listed below, shall be factory assembled on a fabricated steel base plate with structural steel framework. The completed package shall be factory tested, adjusted and certified for the specified flow conditions, and shipped as an integral unit ready for plumbing and electrical connections.
- B. Pumps: Provide multiple stage vertical multiple stage centrifugal type with close-coupled motors, cast iron suction / discharge chamber, motor stool and pump shaft couplings, mechanical seals, 304 stainless steel and impellers, chambers, straps, suction interconnector and neck rings, 431 stainless steel pump shaft and 316 stainless steel bearings, neck rings retainers, split cones, split cone nuts, wear and lock rings.
- C. Motors: Provide variable speed, totally enclosed fan cooled type, operate at 3500 rpm and shall not overload at any point of the pump curve.
- D. Piping: Suction and discharge headers shall be 316 stainless steel with ANSI class 150 pressure rating and flanges welded to the headers. Peak velocity in headers shall not exceed 8 feet per second. Furnish with the following valves:
 - a. Lead Free Ball Valves, 2 Inch and Smaller: Meeting MSS SP-110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, full port, blowout-proof stem and chrome-plated lead free brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.
 - b. Lead Free Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.
 - c. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; 200-psi CWP; lug-type body constructed of cast-iron conforming to ASTM A 126, Class B or ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks for sizes 2-1/2 through 6 inches and gear operators with position indicator for sizes 8 inch and larger. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required.
 - d. Cast Iron Body Ball Valves, 2-1/2" and larger: 200 CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.
 - e. Wafer Check Valves: Class 150, stainless steel body; with replaceable stainless steel seat, and non-slam design lapped and balanced twin stainless steel flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.
- E. Accumulator Tank: Provide tank size as scheduled on the drawings with a minimum pressure rating of 125psig; FDA approved elastomer bladder, tank bottom connection and air charge valve. Tank shall be complete with check valves, isolation valves and pressure reducing valve for remote installation.
- F. Controls and Instruments: Control panel shall be mounted on the pump package and shall include a NEMA 1 enclosure, through door fusible disconnect, disconnect for each pump, overload relays and indicator lights, 120V control circuit transformer with primary and secondary fuse protection, low suction pressure limit switch, suction and discharge header pressure sensors, programmable logic controller and variable speed drives. Touchscreen operator interface for monitoring and adjustment of the programmable

controller variables with virtual on-off-automatic selector switch for each pump, low pressure alarm, high system pressure alarm, pump running indicators and hour meter for each pump. Controls shall be arranged for termination of 1 incoming power feeder. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.

1. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
2. Variable Frequency Drive: The variable speed drives (VFD) shall be adjustable frequency type which employs a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To insure safety of the equipment, the VFD shall include these protective features and options:
 - a. NEMA 1 enclosure.
 - b. Static instantaneous over-current and over-voltage trip.
 - c. Static over-speed (over-frequency) protection.
 - d. Line or fuse loss and under-voltage protection.
 - e. Power unit over-temperature protection.
 - f. Motor inverse time overload protection.
 - g. Input fused disconnect or circuit breaker.
 - h. Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
 - i. Speed meter.
 - j. Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
 - k. Power on light.
 - l. Manual speed potentiometer or control capability through the keypad.
 - m. Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
 - n. Test switch
 - o. VFD fault light and reset.
 - p. Output to the PLC and integral LED display
 - q. The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters and for first fault indication, and digital input programming capability on the main logic board.
 - r. The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
 - s. All control circuit voltages shall be physically and electrically isolated from power circuit voltages.
 - t. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
 - u. Configured for mounting on top of motor or outside of control panel.
3. Pressure Sensors: NEMA 4 water tight enclosure with pressure rating of 2,000psi, stainless steel wetted parts, 0.25" male NPT connection, calibration from 0 to 150 psi with 4-20mA DC signal at 24 VDC. Refer to the floor plans for location of remote pressure sensor.
4. Sequence of Operation: The domestic water booster pump shall be in automatic mode per the design conditions shown on the booster pump schedule. The pump shall modulate its speed to maintain the discharge head pressure setpoint, as determined by the internal control algorithm, simulating the performance of a system utilizing a remote differential pressure sensor. The pumps shall run in a lead/lag operation based on user defined run-time setpoint. When the flow capacity of the lead pump is exceeded, the lag pump shall start after an adjustable time delay. If the capacity of the lead pump and lag pump is exceeded, the second lag pump (and the N+1 sequencing shall continue based on the number of pumps in the system) shall start.
 - a. When a single pump operates at minimum flow rate, the pump speed shall be reduced to the minimum discharge header pressure as scheduled. When required flow increases, the pump

- speed shall increase linearly to the discharge pressure as scheduled at full flow, simulating the performance of a system utilizing a remote differential pressure sensor.
 - b. When the lead pump is stopped because of required zero flow, the pump speed shall increase linearly to the discharge pressure as scheduled to charge the tank, then stop.
- 5. Safeties:
 - a. Low Suction Pressure
 - 1) When the suction pressure drops below the low suction pressure alarm point as determined by the integral suction pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system.
 - b. High Discharge Pressure
 - 1) When the discharge pressure rises above the high discharge pressure alarm point as determined by the integral discharge pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system
 - c. High Flow Shutdown
 - 1) When the discharge flow, as calculated by the control system, rises above the high flow alarm point, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system.
- 6. Control Wire: Domestic booster pump manufacturer shall furnish the appropriate type and amount of wire for interlock of the remote sensors with the domestic booster pump control panel.
- G. Startup Services: Domestic booster pump manufacturer shall provide factory start-up and check out of the booster pump. The Contractor shall provide the Owner's Representative with certification of proper installation and system operation.

2.4 AQUASTATS:

- A. Remote sensing bulb type, non-modulating, single pole double pole throw with surface mount sensing bulb and mounting bracket, adjustable direct reading scale for set point with adjustable differential.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps in accordance with manufacturer's installation instructions.
- B. General: Comply with the manufacturer's written installation and alignment instructions.
- C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.
- E. Suspend inline pumps with althread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

3.2 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.3 CONCRETE EQUIPMENT BASES

- A. Refer to Division 22 Section “Basic Mechanical Materials and Methods” for concrete equipment bases.
 - 1. Form concrete equipment bases by using framing lumber with form release compounds. Chamfer top edge and corners of pad.
 - 2. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.
 - 3. Place concrete and allow to cure before installation of pumps.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.
 - 1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."
- B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
 - 1. Alignment tolerances shall meet manufacturers recommendations.

3.5 CONNECTIONS

- A. General: Install valves that are same size as the piping connecting the pump.
- B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.
- C. Install a nonslam check valve and shutoff valve on the discharge side of pumps.
- D. Install a gate valve and strainer on the suction side of inline pumps.
- E. Install pressure gauges on the suction and discharge of each pump at the integral pressure gauge tapings provided.
- F. Install pressure gauge connector plugs in suction and discharge piping around pump. Pressure gauge connector plugs are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- G. Install surface mounted aquastat on bare metal pipe, fastened securely to pipe upstream of circulator pump when indicated on the drawings.
- H. Interlock aquastat and or timer with hot water recirculation pump motor. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.
- I. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.
- J. Install domestic booster pump remote sensors as recommended by the manufacturer. Coordinate interlock of the sensors and domestic booster pump. Install control wire furnished with the domestic booster pump for interlock with the sensors. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.
- K. Install flexible connectors at the header inlet and outlet of domestic booster pump, refer to Division 22 Section “Basic piping Materials and Methods”.

- L. Provide equipment pad and vibration isolators, refer to Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment”.
 1. Extend equipment pads to 2” beyond elbows, shutoff valves and flexible connectors. Anchor elbows and shutoff valves to equipment pad.
 2. Extend equipment pad to 2” beyond base elbows. Anchor elbows to equipment pad. Install flexible connectors and shutoff valves in the vertical. Anchor shutoff valves to the structure.
- M. Provide concrete inertia base and vibration isolators, refer to Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment”.
 1. Provide an equipment pad, separate from the inertia pad, to 2” beyond elbows, shutoff valves and flexible connectors. Anchor base elbows and shutoff valves to equipment pad.
 2. Provide an equipment pad, separate from the inertia pad, to 2” beyond elbows. Anchor elbows to equipment pad. Install flexible connectors and shutoff valves in the vertical. Anchor shutoff valve to the structure.
- N. Coordinate interlock of high flow rate, low suction pressure and high discharge pressure level alarms with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

3.6 FIELD QUALITY CONTROL

- A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.7 STARTUP

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
 1. Lubricate oil-lubricated bearings.
 2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
 3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
- B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:
 1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
 2. Open the valve in the cooling water supply to the bearings where applicable.
 3. Open the sealing liquid supply valve if the pump is so fitted.
 4. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
 5. Open the recirculating line valve if the pump should not be operated against dead shutoff.
 6. Start motor.
 7. Open the discharge valve slowly.
 8. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
 9. Check the general mechanical operation of the pump and motor.
 10. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.
- C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.

D. Start Up Services for Booster Pump:

1. Certification: Prepare certificates for factory compliance of the installation and completion of factory training signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.

END OF SECTION

SECTION 15420 (221300) - SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
 - 3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
 - 4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
 - 5. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
 - 6. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
 - 7. Division 22 Section "Water Distribution Piping and Specialties," for material and methods for trap primers and trap primer inlet piping.
 - 8. Division 22 Section "Condensate Pumps for HVAC Equipment," for material and methods for condensate pumps.

1.2 DEFINITIONS

- A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
 - 1. Drainage piping
 - 2. Drainage piping specialties

3. Floor drains
4. Interceptors

C. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Comply with the installation requirements for CPVC pipe and CPVC CTS tube per the Lubrizol “FlowGuard Gold and CORZAN Design and Installation Manual” and the installed manufacturer’s installation manual.
- B. Regulatory Requirements: Comply with the provisions of the following codes:
 1. 2019 California Building Code
 2. 2019 California Plumbing Code

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Mfg. Co.
 - c. Mifab Manufacturing Co.
 - d. Sioux Chief Manufacturing Co. Inc.
 - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Industries, Inc.
 - g. Zurn Industries, Inc.; Hydromechanics Div.
 2. Freeze-proof vent caps:
 - a. F.J. Moore Mfg. Co.
 3. Heavy Duty Hubless Couplings
 - a. Anaco Husky HD-2000
 - b. Clamp-All 80in. lb.
 - c. Ideal Tridon “HD”
 - d. Mission Rubber Company, “Heavy Weight”
 - e. ProFlo “HD”
 4. Cast Iron Soil Pipe and Fittings
 - a. AB & I Foundry
 - b. Charlotte Pipe and Foundry Company
 - c. Tyler Pipe / Soil Pipe Division
 5. Shielded Transition Couplings
 - a. FERNCO, “Proflex 3000 Series”
 - b. Mission Rubber Company, “Band Seal Specialty Couplings”
 6. Underground Shielded Adapter Couplings
 - a. FERNCO, “1056 Series with SR73 Shear Ring”
 - b. Mission Rubber Company, “MR56 Series”
 7. Trap Seals
 - a. Green Drain, Inc.
 - b. Jay R. Smith Mfg. Co.
 - c. Mifab Manufacturing, Inc.
 - d. Proset Systems “Trap Guard”
 - e. Rector Seal, Inc.
 - f. Zurn Industries, Inc.; Hydromechanics Div.

8. Hubless Couplings:
 - a. Anaco
 - b. Ideal Tridon
 - c. Mission Rubber Company
 - d. ProFlo "PFNH"
 - e. Tyler Pipe / Soil Pipe Division
9. Plastic Gravity Sand/Oil Separators
 - a. Green Turtle, Inc.
 - b. Mifab Manufacturing, Inc.
 - c. Striem
 - d. Xerxes Corp.
10. PVC DWV Expansion Joints
 - a. Charlotte Pipe and Foundry Company #133
 - b. Spears Manufacturing Company #S119
11. Heavy Duty Hubless Couplings for Below Slab
 - a. Anaco Husky HD-4000
 - b. Clamp-All 125in. lb.
12. "Flowguard Gold" CPVC Water Distribution Tube and Fittings
 - a. Bow Industrial Corp.
 - b. Cresline Plastics Co., Inc. (pipe only)
 - c. Genova Products, Inc.
 - d. NIBCO Inc. (fittings only)

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.
 1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.
 2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.
- B. Copper Tube: ASTM B306, Type DWV, hard drawn for pipe, and cast copper alloy solder joint drainage fittings (DWV) meeting ASME / ANSI B16.23.
 1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.
- C. Copper Tube: ASTM B88, Type M, hard drawn for pipe and wrought copper fittings with soldered joints.
 1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.
- D. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.
 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 2. Solvent: ASTM D2564.
- E. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with "solid wall" PVC meeting ASTM D1784 with cell class 12454.
 1. Solvent: ASTM D2564.
 2. Fittings: Schedule 40 meeting ASTM D2467 with solvent cement socket joints.
- F. "Flowguard Gold" CPVC Water Distribution Tube (1/2" to 2"): ASTM D2846, Copper Tube Size (CTS), pipe with a cell class of 24448 as identified in ASTM 1784. NSF 14 certified and NSF 61 listed. Meeting ASTM E84 for 25 / 50 flame / smoke rating.
 1. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.3 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces and bearing the trademark of CISPI and NSF.
 - 1. Neoprene Compression Gaskets: ASTM C564.
- B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings and bearing the trademark of CISPI and NSF.
 - 1. Heavy-Duty couplings and compression gaskets: ASTM C564, ASTM C1540 and FM 1680.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
 - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 - 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.
 - 1. Solvent: ASTM D2564.
 - 2. Fittings: Schedule 40 meeting ASTM D2467 with solvent cement socket joints.
- E. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Cleanout Plugs: As specified on the drawings.
- B. Floor Cleanouts: As specified on the drawings.
- C. Wall Cleanouts: As specified on the drawings.
- D. Floor Drains: As specified on the drawings.
- E. Freeze-Proof Vent Caps: Construct of galvanized iron, copper, or lead-coated copper, sized to provide 1 inch air space between outside of vent pipe and inside of flashing collar extension.
- F. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with caulked type base connection for cast-iron pipes, threaded base for steel pipes.

2.5 PVC DWV EXPANSION JOINTS

- A. Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

2.6 INTERCEPTORS

- A. Interceptor type designations, flow rates, and capacities are indicated on the drawings.
- B. Gravity Sand/Oil Interceptor: Reinforced precast concrete construction by local manufacturer or a plastic sand/oil interceptor acceptable to the local authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

A. Pipe Beds:

1. PVC and ABS Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Install hubless, cast-iron soil pipe and fittings for 15" and smaller soil, waste, and vent pipe.
- B. Install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings, copper sweat X screwed with solder joints, for waste connections from urinals, lavatories, sinks, water coolers, and kitchen equipment to cast iron drainage piping.
- C. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, with 3/4" minimum size and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger for waste connections from kitchen equipment and terminate over floor receptors with air gap.
- D. Condensate drain piping and pumped condensate drain piping inside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.
 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.
 2. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Materials and Methods".
 3. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger. Except no plastic pipe shall be installed in return air plenums.
 4. Install CPVC CTS pipe and fittings, 2" and smaller.
- E. Condensate drain piping outside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope condensate piping at 1/8" per foot minimum slope to discharge point. Discharge to roof receptors or roof drains with air gap.
 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.

2. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Material and Methods".
 3. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger.
- F. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe, except install no plastic pipe in return air plenums.
 - G. Install PVC pressure pipe and fittings for sump pump discharge, except install no plastic pipe in return air plenums.
 - H. Install type "L" copper tube with wrought copper fittings with solder joints for sump pump discharge pipe.
 - I. Install 1/2" type L copper tube for trap primer outlet piping.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller for soil, waste, and vent pipe.
- B. Install hubless, cast-iron soil pipe and fittings 15" and smaller for soil, waste and vent pipe.
- C. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24" and smaller. Install fabricated fittings for 16 inch and larger.
- D. Install PVC pressure pipe and fittings for sump pump discharge.
- E. Install type "K" soft copper tube with wrought copper fittings with solder joints for sump pump discharge pipe, 2" and smaller.
- F. Install 1/2" type K soft copper tube for trap primer outlet piping.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
 1. Install hubless couplings complying with CISPI 310 on soil, waste and vent piping.
 2. Install hubless couplings complying with CISPI 310 on and soil and waste piping 3" and smaller and all vent piping.
 3. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4" and larger.
 4. Install No-Hub fitting restraints on joints 5" and larger at:
 - a. Changes of direction from vertical to horizontal
 - b. 4" branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5" and larger
 - c. Horizontal changes of direction 22-1/2 degrees and greater
 - d. Changes in diameter of two pipe sizes or greater.
- C. Install heavy duty hubless couplings on hubless soil, waste and vent piping below floor.
- D. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

- E. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
- F. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.
- G. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.
- H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section "Basic Piping Material and Methods" for special sealers and materials.
- I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section "Basic Piping Material and Methods" for special sealers and materials.
- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter

bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

- N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- P. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.
- Q. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
 - a. Install high density insulation on insulated pipe.
 - 4. Provide vinyl coated hangers and riser clamps for use with PVC pipe and CPVC CTS tube.
 - 1. Provide roll hangers for individual horizontal runs 100 feet or longer.
 - 2. Provide ceiling flanges attached to the floor, all thread rod and split ring pipe clamps for indirect drains and condensate drains supported from the floor 2" and smaller.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size – In.</u>	<u>Steel Pipe Max. Span – Ft.</u>	<u>Copper Tube Max. Span – Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2

10 to 12	12	10	5/8
14 to 15	12	N/A	3/4

<u>Nom. Pipe Size In Inches.</u>	<u>CTS CPVC Tube Max. Span - Ft.</u>	<u>CPVC Tube Min. Rod Dia. - In.</u>
1/2	3	3/8
3/4	3	3/8
1	3	3/8
1-1/4	4	3/8
1-1/2	4	3/8
2	4	3/8

1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of horizontal of PVC piping every four feet.
4. Support vertical PVC / CPVC pipe and tube every six feet, at base of each floor, and provide mid-story guides.
5. Support piping within 12" of each elbow or tee.
6. Support each P-trap.

D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

E. Bracing:

1. Provide horizontal bracing for pipe 4" and larger at intervals not to exceed 40'.

3.8 INSTALLATION OF PIPING SPECIALTIES

A. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil and waste stack.

B. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

C. Floor Cleanouts: Install in below floor building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

D. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.9 INSTALLATION OF FLOOR DRAINS, FLOOR SINKS AND FLOOR TROUGHS

- A. Install floor drains, floor sinks, shower linear trench drains and floor troughs in locations indicated.
- B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.
- C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED - FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to the sanitary sewer.
- E. Install floor drains, floor sinks, shower linear trench drains, and floor troughs in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF TRAP PRIMERS

- A. Install trap primer outlet piping with 1/32" per foot slope towards drain trap where possible.
- B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.
- C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2" thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation" for flexible unicellular insulation.
- D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:
 - 1. Install below elevated floor slabs.
 - 2. Install in the sub grade of slab on grade.
- E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.
- F. Refer to Division 22 Section "Water Distribution Piping and Specialties" for trap primer and trap primer inlet pipe requirements.

3.11 INSTALLATION TRAP SEALS:

- A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.

- B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.
- C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.
- D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.12 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 FIELD QUALITY CONTROL

- A. Inspections
 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
 - d. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
 3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1" water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
 5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

SECTION 15452 (221328) - CONDENSATE PUMPS FOR HVAC EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes the following types of plumbing pumps:
 - 1. Condensate pumps for HVAC equipment
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
 - 2. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for condensate pipe material and installation requirements.
 - 3. Division 23 Section "Direct-Digital Control for HVAC" for interlock with HVAC equipment and interlock of alarms with building automation system and alarm wiring.
 - 4. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 - 5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
 - 2. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
 - 3. Maintenance data for condensate pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.3 QUALITY ASSURANCE

- A. Hydraulic Institute Compliance: Design, manufacture, and install condensate pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."
- C. UL Compliance: Plenum rated condensate pumps shall be listed and labeled by UL and comply with Standard 2043 "Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces".
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- E. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.
- F. Design Criteria: The Drawings indicate capacity, connections, and power requirements of condensate pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.4 WARRANTY

- A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.
 - 1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Non-Plenum Rated HVAC Condensate Pump:
 - a. Little Giant
 - b. Liberty Pumps
 - 2. Plenum Rated HVAC Condensate Pump:
 - a. Little Giant with no substitutions

2.2 PUMPS, GENERAL

- A. Condensate Pumps: Factory assembled and factory tested.
- B. Preparation for shipping: Provide suitable packaging to protect pump from damage during shipping.

2.3 CONDENSATE PUMPS OR HVAC EQUIPMENT

- A. General Description: Pumps shall be direct connected, single stage type with body and reservoir of a material suitable for plenum or non-plenum installation as scheduled on plans, normally open safety overflow switch with two dry contacts, integral check valve and power cord with ground.
- B. Non-plenum rated: Reservoir and body shall be either ABS or PE plastic.
- C. Plenum rated: Reservoir and body shall be all polypropylene and meet UL 2043.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Install pumps in locations and arrange to provide access for periodic maintenance.
- C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

3.2 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

- B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.3 CONNECTIONS

- A. Piping between the HVAC unit and the pump shall be the greater of the discharge port size on the HVAC equipment or 3/4" pipe size or as shown on plans, whichever is larger. Discharge piping from the condensate pump shall be equal to or greater than the diameter of the pump nozzle, minimum 3/4", or as shown plans, whichever is larger. Condensate pump discharge pipe material is specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".
- B. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".
- C. Coordinate interlock of condensate pump safety overflow switch with unit served to disable unit if safety overflow switch closes as noted on plans and schedules. HVAC interlock wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

3.4 STARTUP

- A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:
 - 1. Ensure pump is connected to the condensate discharge system.
 - 2. Verify all power wiring is in place and power is provided to pump.
- B. Testing procedure for condensate pumps:
 - 1. Pour water into the pump reservoir until the water sensing switch is activated.
 - 2. Verify water is pumped out of the reservoir and that there are no leaks in the condensate piping or at the connection point to the pump.
 - 3. Verify integral check valve is operating properly, replace with new if found to be defective.

END OF SECTION

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SECTION 15430 (221400) - STORM DRAINAGE PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes building storm drainage piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment," for labeling and identification of drainage piping.
 - 3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
 - 4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
 - 5. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage piping.
 - 6. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.

1.2 DEFINITIONS

- A. Storm Building Drain: That part of the lowest piping of a drainage system which receives the discharge from storm drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Storm Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer or private sewer or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys storm water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
 - 1. Drainage piping
 - 2. Drainage piping specialties
 - 3. Area drains
 - 4. Roof drains
 - 5. Hubless fitting restraints
 - 6. Interceptors
- C. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following codes:

1. 2019 California Building Code
 2. 2019 California Plumbing Code
- B. Comply with the installation requirements for PVC gasketed sewer pipe per the Uni-Bell PVC Pipe Association "Installation Guide for Solid Wall PVC Sewer Pipe". Comply with the installation requirements for gasketed fittings per the Uni-Bell PVC Pipe Association "Installation Guide for PVC Fittings and Laterals for Solid Wall PVC Sewer Pipe".
- C. Obtain installation training from the PVC gasketed sewer pipe manufacturer for all workers that will be installing or handling the PVC gasketed sewer pipe piping systems. Submit certification letter along with each workers certificate of completion to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, area/roof drains, cast-iron trench drains and downspout nozzles:
 - a. Josam Mfg. Co.
 - b. Sioux Chief Manufacturing Co. Inc.
 - c. Smith (Jay R) Mfg. Co.
 - d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - e. Watts Industries, Inc.
 - f. Zurn Industries, Inc.; Hydromechanics Div.
 - g. [Mifab Manufacturing, Inc.]
 2. Heavy Duty Hubless Couplings
 - a. Anaco Husky HD-2000
 - b. Clamp-All 80in. lb.
 - c. Ideal Tridon "HD"
 - d. Mission Rubber Company "Heavyweight"
 - e. ProFlo "HD"
 3. Downspout Boots
 - a. Construction Castings Company
 - b. Flockart
 - c. Higgins Foundry
 - d. Neenah Foundry Company
 4. Cast Iron Soil Pipe and Fittings
 - a. AB & I Foundry
 - b. Charlotte Pipe and Foundry Company
 - c. Tyler Pipe / Soil Pipe Division
 5. Shielded Transition Couplings
 - a. FERNCO, "Proflex 3000 Series"
 - b. Mission Rubber Company, "Band Seal Specialty Couplings"
 6. Underground Shielded Adapter Couplings
 - a. FERNCO, "1056 Series with SR73 Shear Ring"
 - b. Mission Rubber Company, "MR56 Series"
 7. PVC DWV Fittings 16" and Larger
 - a. Plastic Trends, Inc.
 8. Hubless Fitting Restraints
 - a. Holdrite
 9. Plastic Hydromechanical Sand/Oil Separators:
 - a. CANPLAS
 - b. Green Turtle, Inc.

- c. Mifab Manufacturing, Inc.
- d. Striem
- 10. Plastic Gravity Sand/Oil Separators
 - a. Green Turtle, Inc.
 - b. Mifab Manufacturing, Inc.
 - c. Striem
 - d. Xerxes Corp.
- 11. PVC DWV Expansion Joints
 - a. Charlotte Pipe and Foundry Company #133
 - b. Spears Manufacturing Company #S119
- 1. Heavy Duty Hubless Couplings for Below Slab
 - a. Anaco Husky HD-4000
 - b. Clamp-All 125in. lb.

2.2 ABOVE GROUND DRAINAGE PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings, and bearing the trademark of CISPI and NSF.
 - 1. Heavy duty couplings and compression gaskets: ASTM C564, ASTM C1540 and meeting FM 1680.
- B. Copper Tube: ASTM B306, Type DWV, hard drawn for pipe, and cast-bronze, drainage pattern fittings with soldered joints.
 - 1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
 - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints. Fittings 16” and larger shall be fabricated type.
 - 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.
 - 1. Solvent: ASTM D2564.
- E. Steel Pipe: ASTM A53, Type E or S, schedule 40, Grade B, galvanized, threaded ends.
 - 1. Galvanized Malleable Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.
- F. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings, and bearing the trademark of CISPI and NSF. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.
 - 1. Neoprene Compression Gaskets: ASTM C564.
- B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings and bearing the trademark of CISPI and NSF.]
 - 1. Heavy-Duty couplings and compression gaskets: ASTM C564, ASTM C1540 and FM 1680.

- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
 - 1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 - 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.
 - 1. Solvent: ASTM D2564.
- E. PVC Gasketed Sewer Pipe: SDR 26 pipe meeting ASTM F679 with “solid wall” PVC meeting ASTM D1784 and with integral bell type gasketed joints meeting ASTM D3212 with beveled male pipe ends and insertion depth markers.
 - 1. Gasketed Fittings: Drainage pattern type meeting ASTM D3034 with integral bell type gasketed joints meeting ASTM D3212 with beveled male pipe ends.
- F. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- B. Cleanout Plugs: As specified on the drawings.
- C. Floor Cleanouts: As specified on the drawings.
- D. Wall Cleanouts: As specified on the drawings.
- E. Area drains: As specified on the drawings.
- F. Roof Drains: As specified on the drawings.
- G. PVC DWV Expansion Joints: Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

2.5 HUBLESS FITTING RESTRAINTS

- A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

2.6 SAND/OIL INTERCEPTORS

- A. Interceptor type designations, flow rates, and capacities are indicated on the Drawings.
- B. Hydromechanical Sand/Oil Interceptor: As scheduled on the drawings
- C. Gravity Sand/Oil Interceptor: Reinforced precast concrete construction by local manufacturer or a plastic sand/oil interceptor acceptable to the local authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install pipe and specialties in accordance with manufacturer’s installation instructions.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

A. Pipe Beds:

1. PVC and ABS Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Install hubless, cast-iron soil pipe and fittings 15" and smaller for storm pipe.
- B. Install Type DWV copper tube with cast bronze Type DWV fittings 15" and smaller for storm pipe where indicated on the drawings.
- C. Install PVC pressure pipe and fittings for sump pump discharge, except no plastic pipe shall be installed in return air plenums.
- D. Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.
- E. Install galvanized schedule 40 steel pipe and malleable iron fittings for sump pump discharge pipe.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller storm pipe.
- B. Install hubless, cast-iron soil pipe and fittings 15" and smaller for storm pipe.
- C. Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe. Install fabricated fittings for 16 inch and larger.
- D. Install PVC gasketed sewer pipe and gasketed fittings for 27" and larger storm pipe.
- E. Install PVC pressure pipe and fittings for sump pump discharge.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
 1. Install heavy duty hubless couplings on storm drainage piping, including connections to roof drains.
 2. Install Hubless fitting restraints on joints 5" and larger at:

- a. Changes of direction from vertical to horizontal
 - b. 4" branch connections, including tees, wyes and wye combination fittings to storm drainage piping 5" and larger
 - c. Horizontal changes of direction 22-1/2 degrees and greater
- C. Install heavy duty hubless couplings on hubless storm piping ping below floor.
 - D. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.
 - E. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
 - F. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.
 - G. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.
 - H. Gasketed Fittings: Install fittings per the Uni-Bell PVC Pipe Association "Installation Guide for PVC Fittings and Laterals for Solid Wall PVC Sewer Pipe".

3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.
- H. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors,

non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Make changes in direction for drainage piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- M. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- N. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.
- O. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Storm service piping is specified in a separate section of Division 2.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
 - a. Install high density insulation on insulated pipe.
 - 4. Provide vinyl coated hangers and riser clamps for use with PVC pipe.
 - 5. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size	Steel Pipe Max. Span	Copper Tube Max. Span.	Min. Rod Dia. - Inches
<u>In Inches</u>	<u>In Feet</u>	<u>In Feet</u>	
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8

2-1/2 to 3	12	10	3/8
4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support all sizes of hubless horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide sway brace on horizontal piping at not more than 40' intervals to prevent horizontal movement. Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of vertical steel piping every other floor, not to exceed twenty-five feet.
4. Support all sizes of horizontal of PVC piping every four feet.
5. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
6. Support vertical PVC pipe and tube every six feet, at base of each floor, and provide mid-story guides.
7. Support piping within 12" of each elbow or tee.

D. Bracing:

1. Provide horizontal bracing for pipe 4" and larger at intervals not to exceed 40'.

E. Bracing for above floor base of stacks 4" and larger and higher than three stories:

1. Secure horizontal base of stack to structure with riser clamp within at the fitting changing direction of flow from vertical to horizontal. Provide rods of size equal to cast iron pipe size scheduled above in pipe hanger schedule.

3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Install backwater valves in storm building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.
- C. Install expansion joints on stacks or horizontal piping as indicated, and as required by the plumbing code.
- D. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
 1. as required by plumbing code;
 2. at each change in direction of piping greater than 45 degrees;
 3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
 4. at base of each vertical soil, waste, or storm water stack.
- E. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- F. Floor Cleanouts: Install in below floor building drain piping as indicated and:
 1. as required by plumbing code;

2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

G. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.9 INSTALLATION OF AREA DRAINS

- A. Install area drains in locations indicated.
- B. Install area drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
- C. Refer to architectural documents for floor slope requirements and set area drain elevation to match. Where architectural documents do not indicate the requirements, set the area drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

DEPRESSION IN INCHES RADIUS OF AREA DRAINED - FEET

1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to combined sanitary and storm sewer.
- E. Install area drains in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF ROOF DRAINS

- A. Install roof drains at low points of roof areas with the roof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and roof membrane.
- B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
- C. Position roof drains so that they are accessible and easy to maintain.

3.11 FIELD QUALITY CONTROL

- A. Inspections
 1. Do not enclose, cover, or put into operation the storm drainage piping system until it has been inspected and approved by the authority having jurisdiction.
 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

- a. Rough-in Inspection: Arrange for inspection of the storm drainage piping system before concealed or closed-in after system is roughed-in.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
 - d. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test: Test storm drainage system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
- 1. Test for leaks and defects all new storm drainage piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
 - 3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of storm drainage piping systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 - 4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
 - 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.12 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers and domes. Remove dirt and debris.

3.13 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed PVC Piping: Protect storm drainage piping exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

SECTION 15481 (221500) - GENERAL SERVICE COMPRESSED AIR SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes piping, equipment, and related accessories, for general building, compressed air systems operating at 200 psig and below.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
 - 2. Division 22 Section, "Common Work Results for Plumbing" for materials and methods for fire barrier penetrations, wall and floor penetrations and concrete equipment pads.
 - 3. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
 - 4. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and fittings.
 - 5. Division 22 Section "Hangers and Supports for Plumbing Piping" for equipment and piping hangers and supports.
 - 6. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
 - 7. Division 22 Section "Seismic Controls for Plumbing Piping and Equipment" for field-installed seismic restraint devices used for equipment and piping systems.
 - 8. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 - 9. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 DEFINITIONS

- A. Low-Pressure Compressed Air Systems: ASME B31.9 "Building Services Piping" for systems operating at pressure of 125 psig or less, and temperature 200 deg F or less.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories for all equipment; indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
- C. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to equipment. Include ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory-installed and portions that are field-installed.
- D. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.
- E. Coordination drawings for compressed air systems in accordance with Division 22 Section "General Plumbing Requirements."

- F. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: NFPA 70 "National Electrical Code."
- B. Listing and Labeling: Provide equipment that is listed and labeled.
 - 1. Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
 - 3. Furnish control panels manufactured in accordance with UL 508A.
- C. ASME Code Compliance: Provide system components complying with the following:
 - 1. Receiver Tanks: Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, and bear the appropriate code symbols.
 - 2. Safety Valves: ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, National Board certified, bear the appropriate labeling, and have been factory-sealed after testing.
 - 3. Low-Pressure Systems Piping: ASME B31.9, Building Services Piping.
- D. Aluminum Tubing Systems:
 - 1. All Aluminum tubing system components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability.
 - 2. Aluminum Tubing system mechanical piping shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-39.1, ASME, UL/ULC, IAPMO or ICC.
 - a. Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.1 and ANSI B31.9.
 - 3. Aluminum tubing system product manufacturer shall be ISO certified.
 - 4. Aluminum tubing system grooving and cutting tools shall be of an approved manufacturer by the grooved fittings manufacturer. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.
 - 5. Obtain training from the Aluminum Tubing system manufacturer for all workers that will be installing or handling the Aluminum Tubing system.
- E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.
- F. Design Concepts: The Drawings indicate capacities, sizes, and dimensional requirements of system components and are based on the specific types, manufacturers, and models indicated. Components having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, and other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality of products is on the proposer. Refer to Division 1.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Quincy Compressor Div.; Coltec Industries, Inc.
 - 2. Aftercoolers, Air Cooled:
 - a. Arrow Pneumatics, Inc.
 - b. Curtis-Toledo, Inc.

- c. Hankison Div.; Hansen, Inc.
- d. Ingersoll-Rand Co.
- e. Saylor-Beall Manufacturing Co.
- f. Van Air Systems, Inc.
- g. Zeks Air Drier Corp.
- 3. Air Dryers:
 - a. Zeks Air Drier Corp.
- 4. Air Filters:
 - a. Deltech Engineering, L.P.
 - b. Hankison Div.; Hansen, Inc.
 - c. Ingersoll-Rand Co.
 - d. Ultrafilter, Inc.
 - e. Zurn Industries
- 5. Air Regulators & Lubricators:
 - a. Arrow Pneumatics, Inc.
 - b. Champion Pneumatic Machinery Co., Inc.
 - c. Wilkerson.
- 6. Automatic Drain Valves:
 - a. Arrow Pneumatics, Inc.
 - b. Deltech Engineering, L.P.
 - c. Ingersoll-Rand Co.
 - d. Zurn Industries
- 7. Quick Connect/Disconnect Hose Couplings:
 - a. Aeroquip Corp.; Industrial Connectors Div.
 - b. Bowes Manufacturing, Inc.
 - c. Amflo Products Div.; Bridge Products Inc.
 - d. Foster Manufacturing Co., Inc.
 - e. Hansen Coupling Div.; Tuthill Corp.
 - f. Milton Industries, Inc.
 - g. OBAC Corp.
 - h. Schrader Automotive, Inc.
 - i. Snap-Tite, Inc.
- 8. Ball Valves – 2” and smaller:

<u>MANUFACTURER</u>	<u>THREADED ENDS</u>	<u>SOLDER ENDS</u>
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70
- 9. Ball Valves – 2” to 4”:

<u>MANUFACTURER</u>	<u>THREADED ENDS</u>	<u>SOLDER ENDS</u>
Apollo	82-100	82-200
Hammond	8604	8614
Milwaukee	BA-300	BA-350
Nibco	T-595-Y	S-595-Y
- 10. Check Valves – 2” and smaller:

<u>MANUFACTURER</u>	<u>THREADED ENDS</u>	<u>SOLDER ENDS</u>
Apollo	161S	161T
Hammond	IB940	IB945
Milwaukee	509-T	1509-T
Nibco	T-413-Y	S-413-Y
- 11. Check Valves – 2” to 4”:
 MANUFACTURER
 Apollo 910F
 Hammond IR1124

Milwaukee F2974
Nibco F-918-B

12. Aluminum Tube Systems
 - a. AIRPipe USA
 - b. Applied Systems Technologies, "INFINITY" for 2-1/2" and smaller, "ELEVATION" for 3" and larger
 - c. Atlas-Copco "AIRNet"
 - d. Ingersol-Rand "SimplAir"
 - e. Transair

2.2 PIPE AND TUBE MATERIALS

- A. Aluminum Tube: ASTM B241, Aluminum 6063-T5 (through the full wall thickness), rigid grade, blue in color, T5 thermal hardness treatment, powder coated.

2.3 PIPE AND TUBE FITTINGS

- A. Aluminum Tube System Fittings:
 1. 2-1/2" and smaller: Polyamide with fiberglass reinforcement meeting UL94HB with compression joints with nitrile rubber O-ring seals.
 2. 3" and larger: Aluminum body with compression joints with nitrile rubber O-ring seals.
 3. 2" and smaller rated at maximum pressure of 232 psi at 188F.
 4. 2-1/2" and larger rated at maximum pressure of 188 psi at 158F.

2.4 VALVES

- A. Ball Valves, 2 Inch and Smaller: MSS SP-110, Class 150 saturated steam pressure, 600-psi CWP; two-piece construction; with bronze body conforming to ASTM B 584, full port, chrome-plated brass ball, replaceable PTFE (Teflon) seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for use with copper tubing or threaded ends for use with steel piping. Provide Class 150 valves meeting the above where system pressure requires. Provide with side vented ball where required.
- B. Ball Valves, 2-1/2 Inch to 4 Inch: MSS SP-110, Class 150, 600-psi CWP; 3-piece construction; with bronze body conforming to ASTM B 584, full port, chrome-plated brass ball, replaceable PTFE (Teflon) seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for use with copper tubing or threaded ends for use with steel piping.
- C. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, 200-psi CWP, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and PTFE (Teflon) disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150, 300-psi CWP, valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
- D. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with horizontal swing, bronze disc or ductile iron disc with bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

2.5 JOINING MATERIALS

- A. Aluminum Tubing System: Nitrile rubber O-ring seals.

2.6 ROTARY SCREW AIR COMPRESSORS

- A. General: Provide factory-assembled and tested, packaged, single-stage, heavy-duty, asymmetrical, rotary screw air compressors as indicated, of capacities and having electrical characteristics as indicated.
- B. Bearings: Separate axial and thrust anti-friction bearings.
- C. Coupling: Nonlubricated flexible type.
- D. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package, prepiped to unit with air pressure circulation system, with coolant stop valve, full flow coolant filter, and thermal bypass valve.
- E. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
- F. Air/Coolant Receiver and Separation System: 150-psig-rated tank with ASME safety valve; coolant level gauge; multistage, air coolant separator element; minimum pressure valve; blowdown valve; discharge check valve; and coolant stop valve, full flow coolant filter, and thermal bypass valve.
- G. Capacity Control: Capacity modulation between 0 and 100 percent air delivery, with operating pressures between 50 and 125 psig using manufacturer's standard control. Control inlet butterfly valve by diaphragm and pressure regulator to hold a constant pressure. When air demand is zero, unload compressor by use of pressure switch and blowdown valve.
- H. Control Panel: Include air receiver pressure gauge, discharge line pressure gauge, air filter maintenance indicator, hourmeter, compressor discharge air and coolant temperature gauge, control transformer, start-stop switches, and numbered wiring terminal strip.
 - 1. Provide automatic alternator to switch lead compressor at each start, for duplex air compressor units.
- I. Motor Starter: Full-voltage, magnetic starter with NEMA 12 enclosure. Factory mount starter on compressor package and wire to motor and control panel.
- J. Receiver Tank: ASME stamped.
- K. Prepipe entire unit at factory.
- L. Oil-Flooded, Rotary Screw Air Compressors: Oil-cooled and oil-flooded lubricated screws.
- M. Electronic Demand Expander with Fail/ Open control and three-valve bypass. Unit shall be communication ready with ability to remote monitor. Accuracy shall be +/- 2 PSI with an operating range of 80-125 PSIG.
- N. Disconnect: Disconnect is provided under Division 26.

2.7 AFTERCOOLERS

- A. Aftercoolers, Air Cooled: Tubular, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.

2.8 AIR DRYERS

- A. Air Dryers, Refrigerated Type: Provide with capacities and characteristics as indicated on the drawings. Equip with drain connection.

2.9 ACCESSORIES

- A. General: Provide accessories having working pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.
- B. Intercoolers: Air-cooled, fixed-bundle, tubular intercoolers, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.
- C. Separators: Conical shaped, centrifugal air-line separators in sizes and capacities indicated. Equip with water-removal trap and drain. Size units for maximum pressure drop through units of 3 psig from air inlet to outlet.
- D. Receivers: ASME stamped, cylindrical, vertical or horizontal installation as indicated, galvanized steel; with safety valves in sizes, working pressures and temperatures indicated, and with drain connection.
 - 1. Pressure rating: Not less than maximum discharge pressure.
- E. Safety Valves: ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels construction, National Board certified, labeled, and factory-sealed; constructed of bronze body with poppet safety valve for compressed air service.
 - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- F. Pressure Regulators: Bronze body, direct-acting, spring-loaded, manual pressure setting adjustment, and rated for 250-psig inlet pressure except where otherwise indicated.
 - 1. Type: Diaphragm-operated.
 - 2. Type: Pilot-operated.
- G. Pressure Regulators (Reducing Valves): Aluminum alloy or plastic body, diaphragm-operated, direct-acting, spring-loaded, manual pressure setting adjustment, and rated for 250-psig inlet pressure except where otherwise indicated.
- H. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering air stream; with oil feed adjustment screw, and quick-release collar for easy bowl removal.
 - 1. Provide with automatic feed device for supplying oil to lubricator.
- I. Filters: Capacities and types indicated on the drawings. Equip with cartridges capable of removing particles, water and oil aerosols, and with warning light to indicate when selected maximum pressure drop has been exceeded with characteristics indicated on the drawings.
- J. Automatic Drain Valves: Electronic controlled corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.
- K. Hose, Clamps, and Couplings: Provide compatible hose, hose clamps, and hose couplings, suitable for compressed air service, of nominal diameter, and rated for 300-psig minimum working pressure except where otherwise indicated.
 - 1. Quick Connect/Disconnect Hose Couplings: One-way, automatic shutoff, brass body, with O-ring or gasket seal, and stainless steel or nickel-plated steel operating parts. Select socket end with threaded inlet that is considered the fixed end and has a one-way valve.
 - a. Plug End: Flow-sensor bleeder, check-valve type, with serrated outlet for hose.
 - b. Plug End: Straight-through type, with serrated outlet for hose.
 - 2. Quick Connect/Disconnect Hose Couplings: Straight through, brass body, with stainless-steel or nickel-plated steel operating parts. Select socket end with O-ring or gasket seal, and without valve. Select socket and plug ends with serrated outlets for hose.

3. Hose Coupling: Two-piece, threaded, brass or stainless steel, O-ring or gasket seal, swivel coupling, with serrated ends, 300-psig minimum working pressure.
4. Hose Adapter: One-piece, brass or stainless-steel fitting, with serrated ends.
5. Hose: Reinforced, single- or double-braid, neoprene-covered hose, for compressed air service.
6. Hose Clamps: Stainless steel, clamps, bands, or wire.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

- A. Install air compressors, air dryers, accessories, piping, valves and specialties in accordance with manufacturer's installation instructions.

3.1 CONCRETE EQUIPMENT BASES

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for concrete equipment bases.
 1. Form concrete equipment bases by using framing lumber with form release compounds. Chamfer top edge and corners of pad.
 2. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.
 3. Place concrete and allow to cure before installation of pumps.

3.2 EQUIPMENT INSTALLATION

- A. Install air compressors on concrete bases. Set and connect units in accordance with manufacturers' written installation instructions. Install units plumb and level, firmly anchored, in locations indicated, and maintain manufacturers' recommended clearances. Orient so equipment controls and devices needing servicing are accessible. For indirect drain material and installation.
- B. Install seismic restrains for equipment as indicated refer to Division 22 Section "Seismic Controls for Plumbing Piping and Equipment".
- C. Install flexible connectors where indicated on the drawings. Refer to Division 22 "Basic Piping Material and Methods" for installation.
- D. Install indirect drains on air compressor accumulator tank drain valve, air dryer condensate drain and each automatic air drain valve and route to nearest floor drain. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".
- E. Provide equipment pad and vibration isolation, refer to Division 22 Section "Vibration Isolation For Plumbing Piping & Equipment".

3.3 PIPING APPLICATIONS

- A. 6 inches and smaller: Aluminum tube with compression fittings.

3.4 JOINT CONSTRUCTION

- A. Aluminum Tubing Systems: Install per manufacturers' published installation instructions.

3.5 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shut-off duty - 2" and smaller: Use 2-piece ball valves.
 - a. Provide side vented ball valves only at individual equipment connections and air drops to relieve air downstream of ball valve when closed for equipment repair or removal.
 - 2. Shut-off duty - 2-1/2" and larger: Use 3-piece ball valves.
 - 3. Valves for aluminum tubing systems: Provide valves specified herein with threaded by Aluminum Tube compression adapters as required.

3.6 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, and elsewhere as indicated.
- B. Shutoff Valves: Install shutoff valves on outlet of each compressed air equipment item, on each supply to each compressed air outlet, and elsewhere as indicated.
- C. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.
- D. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- E. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- F. Install valves in horizontal piping with stem at or above the center of the pipe.
- G. Install valves in a position to allow full handle rotation.
- H. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.

3.7 PIPING INSTALLATION, GENERAL

- A. Install air and drain piping with 1/8-inch-per-foot slope downward in direction of air flow.
- B. Install eccentric reducers where pipe is reduced in size in the direction of flow, with bottoms of both pipes and reducer flush.
- C. Connect branch air piping to mains from top of main. Provide drain leg and drain trap at end of each main, each branch, and each low point in piping system.
- D. Install horizontal piping as high as possible. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- E. Install piping specialties in accordance with Division 22 Section "Basic Piping Materials and Methods."
- F. Install supports and anchors in accordance with Division 22 Section "Hangers and Supports for Plumbing Piping."
 - 1. Spacing: Do not exceed 10'-0" spacing between pipe hangers.

- G. Install valves in accordance with Division 22 Section "General Duty Valves for Plumbing Piping."
- H. Install thermometers and pressure gauges in accordance with Division 22 Section "Meters and Gauges for Plumbing Piping."
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- M. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Dielectric unions and flanges are specified in Section "Basic Piping Materials and Methods".
- N. Joints at Valve Assemblies: Provide unions downstream of shutoff valves at valve assemblies. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.8 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping." Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
 1. Adjustable band hangers, MSS SP-69 Type 7, for steel pipe for individual horizontal runs and for copper tube for horizontal runs.
 2. Steel riser clamps, MSS SP-69 Type 8, for individual vertical runs of steel pipe.
 3. Plastic coated adjustable band hangers with, MSS SP-69 Type 7, for copper tube for horizontal runs.
 4. Plastic coated steel riser clamps, MSS SP-69 Type 8, for individual vertical runs of copper tube.
 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of steel pipe 2" and smaller on walls or for securing steel pipe inside walls.
 6. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls or for securing copper tube inside walls.
 7. Provide roll hangers for individual horizontal runs 100 feet or longer.
 8. Aluminum tubing system fixing clips, clamps, and hangers.
- C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

<u>Nom. Pipe Size - In.</u>	<u>Steel Pipe Max. Span - Ft.</u>	<u>Copper Tube Max. Span - Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8

2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2

<u>Nom. Pipe Size - In.</u>	<u>Aluminum Tube Max. Span - Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8
2-1/2	9	1/2
3	10	1/2
3-1/2	11	1/2
4	12	5/8
6	13	3/4

1. Support vertical aluminum tube at each floor and in intervals not to exceed 10 feet.

D. Support piping within 12” of each elbow or tee and for piping 2-1/2” and larger at each valve or strainer.

E. Support piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

F. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section “Vibration Isolation for Plumbing Piping and Equipment”.

3.9 CONNECTIONS

A. Install piping adjacent to equipment to allow servicing and maintenance.

B. Connect air piping to units with shutoff valves and unions.

- Where air piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
- Install thermometers on compressor discharge piping, on receiver tanks, and where indicated.
- Install pressure gauges on compressor discharge piping, on receiver tanks, and where indicated.

C. Install safety valves in receiver tanks, in quantity and size to relieve capacity not less than that of connected compressor.

D. Install automatic drain valves on intercoolers, aftercoolers, separators, receivers, dryers, filters and other locations indicated. Discharge condensate over nearest floor drain.

E. Install flexible connectors where indicated in accordance with Division 22 Section "Basic Piping Materials and Methods".

F. Securely attach hose reels to the structure as specified in Division 22 Section "Hangers and Supports for Plumbing Piping."

G. Electrical Connections:

- Power wiring is specified in Division 26 Section “Common Work Results for Electrical”

2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.10 FIELD QUALITY CONTROL

- A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide startup service, and to demonstrate and train Owner's maintenance personnel as specified below.
 1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.
- B. Aluminum Tubing Systems:
 1. Installing contractor shall schedule training session with the Aluminum Tubing systems manufacturer for all workers that will be installing or handling the grooved or press to connect piping systems. Submit certification letter along with list of attendees to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.
 2. Aluminum Tubing systems manufacturer shall provide certification training to contractor without cost and without additional cost to Owner.
 3. Installing contractor shall visually inspect couplings and repair or replace any Aluminum Tubing systems misaligned couplings and couplings with gaps prior to calling for inspection as defined in Division 22 Section "General Plumbing Requirements."
 4. Aluminum Tubing systems manufacturer's representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is following the latest published manufacturer's field installation instructions and best practice procedures provided during the training session.

3.11 STARTUP

- A. Preparation: Perform the following final checks before startup:
 1. Complete tests of piping systems.
 2. Check for piping connection leaks.
 3. Check lubricating oil for lubricated-type equipment.
 4. Check V-belts for proper tension.
 5. Check that compressor inlet filters and piping are clear.
 6. Check equipment vibration-control supports and flexible pipe connectors, and that equipment is properly attached to substrate.
 7. Check for proper seismic restraints.
 8. Check that safety valves have correct setting; greater than compressor discharge pressure, but not greater than pressure rating of system components.
 9. Test operation of equipment safety controls and devices.
 10. Drain receiver tanks.
 11. Check for adequate room ventilation.
- B. Starting Procedures: Follow the manufacturer's written procedures. If no procedures are prescribed by the manufacturer, proceed as follows:
 1. Energize circuits.
 2. Start and run equipment through complete sequence of operations.
 3. Check for excessive vibration and noise. Correct problems.
 4. Check air pressures.
 5. Manually operate safety valves.
 6. Adjust operating controls including pressure settings.

3.12 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
 - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 15460 (223300) - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes electric water heaters.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Common Work Results for Plumbing" for concrete equipment pads.
 - 2. Division 22 Section "Basic Piping Materials and Methods" for pipe joining materials, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
 - 3. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
 - 4. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 - 5. Division 26 Section "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
 - 2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
 - 3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.3 QUALITY ASSURANCE

- A. UL Standards: Provide water heaters complying with the following:
 - 1. UL 174, "Household Electric Storage Tank Water Heaters."
 - 2. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters."
- B. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."
- C. Listing and Labeling: Provide water heaters that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- D. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."
- E. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, or other

characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of water heaters is on the proposer.

1.4 WARRANTY

- A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, and coils. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
1. Point-of-Use Storage Electric Water Heaters:
 - a. Tank: Six years
 - b. Controls and Other Components: Six years
 2. Point-of-Use Tankless Electric Water Heaters:
 - a. Leaks: Five years
 - b. Controls and Other Components: One year
 3. Commercial Electric Water Heaters:
 - a. Tank: Three years
 - b. Controls and Other Components: One year

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Point-of-Use Storage Electric Water Heaters:
 - a. Bradford-White Corp.
 - b. In-Sink-Erator, Div.; Emerson Electric Co.
 - c. Lochinvar Water Heater Corp.
 - d. Rheem Mfg.
 - e. Ruud Mfg. Div.; Rheem Mfg.
 - f. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
 - g. State Industries, Inc.
 2. Point-of-Use Tankless Electric Water Heaters:
 - a. Chronomite Laboratories, Inc.
 - b. Eemax, Inc.
 - c. Keltech Inc.
 - d. PVI Industries, Inc.
 - e. Steibel Eltron
 3. Commercial Electric Water Heaters:
 - a. Bock Waters Heaters, Inc]
 - b. Bradford-White Corp.
 - c. Hubbel Water Heater
 - d. Lochinvar Water Heater Corp.
 - e. Rheem Mfg.
 - f. Ruud Mfg. Div of Rheem Mfg.
 - g. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
 - h. State Industries, Inc.
 - i. HTP Comfort Solutions, LLC
 4. Thermal Expansion Tanks
 - a. Armstrong Pumps, Inc.
 - b. Amtrol, Inc.
 - c. Bell & Gosset, ITT
 - d. Elbi
 - e. TACO, Inc.

- f. Watts
- g. Wessels Tank Co.
- 5. Pressure Relief Valves
 - a. Apollo #16LF-202
 - b. Cash ACME #FW
 - c. Watts #LF53
 - d. Wilkins #P1520XL
- 6. Vacuum Relief Valves
 - a. Apollo #37
 - b. Cash ACME #VR-801
 - c. Watts #N36
 - d. Wilkins #VR-10
- 7. Water Heater Drain Pans
 - a. Holdrite
 - b. Killarney Metals
 - c. Oatey

2.2 POINT-OF-USE STORAGE ELECTRIC WATER HEATERS

- A. Description: Automatic, electric, storage type; with 150-psig-rated storage tank, integral controls, and relief valve.
- B. Insulation: Fiberglass or polyurethane foam, surrounding tank.
- C. Jacket: Steel, with baked-on enamel finish.
- D. Tank: 150-psig rated, glass-lined steel, with anode rod.
- E. Heating Element: Single, screw-in, immersion type.
- F. Controls: Adjustable thermostat temperature control.
- G. Safety Controls: Automatic, high-temperature-limit cutoff.
- H. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22, 3/4-inch size.

2.3 POINT-OF-USE TANKLESS ELECTRIC WATER HEATERS

- A. Description: Automatic, electric, wall-mounting, tankless type; with integral controls.
- B. Insulation: Manufacturer's standard.
- C. Jacket: Aluminum or steel with baked-on enamel finish, or plastic.
- D. Heating Element: Resistance heating.
- E. Controls: Adjustable thermostat temperature control. Flow control fitting in inlet piping.
- F. Safety Controls: Automatic, high-temperature-limit cutoff.

2.4 ELECTRIC WATER HEATERS

- A. Description: Automatic, commercial, electric; with vertical, 150-psig-rated storage tank, integral controls, drain valve, and relief valve.

- B. Insulation: Fiberglass or polyurethane foam, surrounding tank.
- C. Jacket: Steel, with baked-on enamel finish.
- D. Tank: Glass-lined steel with anode rods and drain valve.
- E. Heating Elements: Screw-in or flanged bolt-in immersion type, in multiples as described on the drawings.
- F. Controls: Adjustable surface mounted thermostats.
- G. Controls: Adjustable immersion thermostats.
- H. Safety Controls: Automatic, high-temperature-limit cutoff.
- I. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

2.5 THERMAL EXPANSION TANKS

- A. ASME Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel ASME labeled for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1.
- B. Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel listed for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base.

2.6 VACUUM RELIEF VALVES

- A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

2.7 PRESSURE RELIEF VALVES

- A. Pressure Relief Valve: 1/2" lead free brass body meeting ANSI Z21.22 with screwed ends, stainless steel spring and factory set to relieve at 100 psig.

2.8 WATER HEATER DRAIN PANS

- A. Galvanized steel or aluminum with outside diameter minimum 2" greater than water heater diameter, with 3/4" screwed drain outlet.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's written instructions. Install units plumb and level, firmly anchored in locations indicated,

and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

- C. Install thermometers on water heater outlet piping. Thermometers and their installation requirements, are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- D. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.
- E. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.
- F. Water Heater Drain Pan: Install under water heater on wall or ceiling supports or resting on elevated floor slabs. Install drain pan drain line to discharge to an approved receptor with air gap.
- G. Install pressure relief valve on cold water supply to water heater downstream of shutoff and check valves. The pressure relief shall be factory set to 100 psig. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

3.2 CONCRETE EQUIPMENT BASES

- A. Construct concrete equipment bases in accordance with Division 22 Section "Common Work Results for Plumbing" for concrete and setting of equipment.

3.3 EXPANSION TANK INSTALLATION

- A. Install in-line expansion tanks in the vertical position. Install in-line expansion tank in the horizontal position when allowed by manufacturer and provided with required supports.
- B. Install stand mounted expansion tanks on concrete equipment bases.
- C. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
 - 2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
 - a. Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2" and smaller and install dielectric flanges for joints 2-1/2" and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
 - b. Install vacuum relief valve in cold water inlet piping.
 - 3. Install drain as indirect waste to spill into open drain or over floor drain.
 - a. Install drain valve at low point in water piping, for water heaters not having tank drain.
 - 4. Install heat traps at inlet and outlet of each water heater storage tank. Heat trap shall be made of elbows and piping. Heat trap shall turn down to 12" below the outlet or inlet, run 12" horizontal and turn up to the cold water to the heater or hot water from the heater. Where multiple tanks are connected with a manifold, a single heat trap may be provided at the connection of the cold water supply to the cold water manifold together.

- B. Electrical Connections:
 - 1. Power wiring is specified in Division 26 Section "Common Work Results for Electrical"
 - 2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
 - 3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.5 FIELD QUALITY CONTROL

- A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.
 - 1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

3.6 STARTUP

- A. Perform the following before start-up final checks:
 - 1. Fill water heaters with water.
 - 2. Piping systems test complete.
 - 3. Check for piping connections leaks.
 - 4. Test operation of safety controls and devices.
- B. Perform the following start-up procedures:
 - 1. Energize circuits.
 - 2. Adjust operating controls.
 - 3. Adjust hot water outlet temperature setting.

3.7 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
 - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 15440 (224000) - PLUMBING FIXTURES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Duty Valves for Plumbing Piping" for valves used as supply stops.

1.2 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.
- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.
- G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.
- H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
 - 1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
 - 2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
 - 3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
 - 4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

- K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
 - 2. Wiring diagrams for field-installed wiring of electrically operated units.
 - 3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
- B. Submit third party certification that faucets and trim for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following faucets and trim need not comply:
 - 1. Electronic faucets
 - 2. Service sink faucets
 - 3. Flush valves
 - 4. Shower valves and heads

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of ICC Standard A117.1, "Accessible and Usable Buildings and Facilities" and "2010 ADA Standards for Accessible Design" with respect to plumbing fixtures for individuals with disabilities.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of faucets and trim containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

1.5 SPARE PARTS

- A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
- B. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
- C. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.

- D. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.
- E. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.
- F. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.
- G. Filter Cartridges: Furnish quantity of identical filter cartridges not less than 50 percent of amount of each type and size installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:
 - 1. Water Closets:
 - a. American Standard, Inc.
 - b. Gerber Plumbing Fixture Corp.
 - c. Kohler Co.
 - d. Sloan Valve Co.
 - e. TOTO KIKI USA, Inc.
 - f. Zurn Plumbing Products Group
 - 2. Urinals:
 - a. American Standard, Inc.
 - b. Gerber Plumbing Fixture Corp.
 - c. Kohler Co.
 - d. Sloan Valve Co.
 - e. TOTO KIKI USA, Inc.
 - f. Zurn Plumbing Products Group
 - 3. Lavatories:
 - a. Acorn Engineering Co.
 - b. American Standard, Inc.
 - c. Gerber Plumbing Fixture Corp.
 - d. Kohler Co.
 - e. PROFLO
 - f. Sloan Valve Co.
 - g. TOTO KIKI USA, Inc.
 - h. Zurn Plumbing Products Group
 - 4. Sinks:
 - a. American Standard, Inc.
 - b. Elkay Manufacturing Co.
 - c. Franke
 - d. Just Manufacturing Co.
 - e. Kohler Co.
 - 5. Service Sinks:
 - a. American Standard, Inc.
 - b. Just Manufacturing Co.
 - c. Kohler Co.
 - 6. Mop Basins:
 - a. Acorn Engineering Co.
 - b. Fiat Products.
 - c. Florestone Products Co., Inc.

- d. Stern-Williams Co., Inc.
- 7. Water Coolers:
 - a. Acorn / Aqua
 - b. Elkay Manufacturing Co.
 - c. Halsey Taylor; A Household International Co.
 - d. Haws Drinking Faucet Co.
- 8. Outlet Boxes:
 - a. Guy Gray Manufacturing Co., Inc.
 - b. Symmons Industries, Inc.
 - c. Oatey Co.
- 9. Emergency Equipment:
 - a. Bradley Corp.
 - b. Chicago Faucet Co.
 - c. ENCON Safety Products
 - d. Guardian Equipment.
 - e. Haws Drinking Faucet Co.
 - f. Speakman Co.
 - g. Stingray Systems
 - h. Water Saver Faucet Co.
- 10. Toilet Seats:
 - a. Bemis Mfg. Co.
 - b. Beneke Div.; Sanderson Plumbing Products, Inc.
 - c. Church Seat Co.
 - d. Kohler Co.
 - e. Olsonite Corp.
 - f. Sperzel Industries, Inc.
- 11. Flushometers – Piston Type:
 - a. American Standard, Inc
 - b. Sloan Valve Co.
 - c. Zurn Industries, Inc.; Flush Valve Operations.
- 12. Commercial/Industrial Cast-Brass Faucets:
 - a. Chicago Faucet Co.
 - b. Delta-Commercial
 - c. Speakman Co.
 - d. T & S Brass and Bronze Works, Inc.
 - e. Zurn Industries, LTD. “Aqua Spec”
- 13. Sensor-Operated Faucets and Devices:
 - a. Sloan Valve Co.
 - b. Zurn Industries, LTD. “Aqua Spec”
- 14. Stop Valves & Supplies:
 - a. Brass Craft Subsidiary; Masco Co.
 - b. Engineered Brass Company
 - c. McGuire Manufacturing Co., Inc.
 - d. PROFLO
 - e. Watts Brass and Tubular
 - f. Zurn Industries
- 15. P-traps, Drains & Miscellaneous Fittings:
 - a. Brass Craft Subsidiary; Masco Co.
 - b. Dearborn Brass
 - c. Engineered Brass Company
 - d. McGuire Manufacturing Co., Inc.
 - e. PROFLO
 - f. Watts Brass and Tubular
 - g. Zurn Industries
- 16. Supports:
 - a. Josam Co.

- b. Smith (Jay R.) Mfg. Co.
 - c. Wade Div.; Tyler Pipe.
 - d. Watts Drainage Products
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 - f. Mifab Manufacturing, Inc.
17. Insulation Kits
- a. Brocar
 - b. McGuire
 - c. Plumberex
 - d. PROFLO
 - e. Trap-Wrap
 - f. Truebro, Inc.

2.2 PLUMBING FIXTURES, GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below:

2.3 FAUCETS

- A. Faucets General: As described on the drawings.
 - 1. Electronic faucets shall be of the same manufacturer as the water closet and urinal flush valves.

2.4 STOP VALVES & SUPPLIES

- A. Supplies General: As described on the drawings.
 - 1. Exposed piping and parts shall be polished chrome plated.

2.5 P-TRAPS, DRAINS AND MISCELLANEOUS FITTINGS:

- A. Fittings General: As described on the drawings, except as listed below.
 - 1. Exposed piping and fittings shall be polished chrome plated.
 - 2. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
 - 3. Fitting and faucet bodies for domestic water distribution shall be of lead free brass or lead free cast bronze.
- B. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.
- C. Scullery sink Continuous Wastes: Polished chrome-plated, tubular brass, 2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.
- D. Escutcheons: Wall flange with set screw.
- E. Escutcheons:
- F. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

2.6 FLUSHOMETERS

- A. Provide flushometers compatible with fixtures, with features and of consumption indicated As described on the drawings.

1. Exposed metal parts shall be polished chrome plated.
2. Flush valves installed within wall construction may be without chrome plate finish.

2.7 TOILET SEATS

- A. General: As described on the drawings.

2.8 PLUMBING FIXTURE SUPPORTS

- A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.
- B. Support categories are:
 1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
 2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
 3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
 4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.
- C. Support Types: Provide support of category specified, of type having features required to match fixture.
- D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

2.9 INSULATION KITS

- A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install fixtures, trim and supports in accordance with manufacturer's installation instructions.

3.2 APPLICATION

- A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.
- B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
 1. Carriers for following fixtures:
 - a. Wall hanging lavatories
 - b. Wall hanging electric water coolers and drinking fountains.
 - c. Wall-hanging fixtures supported from wall construction.
 2. Chair carriers for the following fixtures:
 - a. Wall-hanging urinals.
 - b. Wall-hanging lavatories and sinks.
 - c. Wall-hanging drinking fountains and electric water coolers.
 3. Heavy-duty chair carriers for the following fixtures:
 - a. Accessible lavatories.
 - b. Fixtures where specified.

4. Reinforcement for the following fixtures:
 - a. Floor-mounted lavatories required to be secured to wall.
 - b. Floor-mounted sinks required to be secured to wall.
 - c. Recessed, box-mounted electric water coolers.
 - d. Wall mounted and mop sink faucets.
 - e. Urinal flush valve solid pipe ring supports.

3.3 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.
- B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
- C. Install wall-hanging, back-outlet urinals with gasket seals.
- D. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- E. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- F. Fasten wall-mounted fittings to reinforcement built into walls.
- G. Fasten counter-mounting-type plumbing fixtures to casework.
- H. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- I. Set mop basins in leveling bed of cement grout.
- J. Install stop valve in an accessible location in each water supply to each fixture.
- K. Install trap on fixture outlet except for fixtures having integral trap.
- L. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- M. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.
- N. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.6 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.
- C. Replace washers of leaking and dripping faucets and stops.
- D. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.
- E. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.
- F. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."
- G. Set each shower valve temperature limit stop to 110°F. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium. Provide the architect a report and schedule indicating the hot, cold and mixed maximum water temperature at each shower.

3.7 FIXTURE SCHEDULE

- A. Provide plumbing fixtures as specified on the drawings.
- B. Install rough-in for plumbing fixtures as scheduled on the drawings.

3.8 MOUNTING HEIGHTS SCHEDULE:

- A. Refer to the architectural drawings for plumbing fixture mounting heights. Unless indicated otherwise, install plumbing fixtures with the mounting heights as listed below with final approval by the Architect:

FIXTURE	MOUNTING HEIGHT
Lavatory or Sink	
Standard Height	31" floor to rim
ADA Accessible	34" floor to rim
Child Height	24" floor to rim
Urinal	
Standard Height	24" floor to rim
ADA Accessible	17" floor to rim
Child Height	14" floor to rim
Water Closet	
Standard	15" floor to rim
ADA Accessible	17" to 19" floor to top of seat

Child Height	10" floor to rim
Water Cooler or Drinking Fountain	
Standard Height	41" floor to spout
ADA Accessible	36" floor to spout
Child height	30" floor to spout
Shower Valves	
Standard Height	48" men and 42" women floor to centerline
ADA Accessible	38" minimum to 48" maximum floor to centerline
Shower heads	
Standard Height	6'-6" men, 6'-0" women floor to centerline
Ice Maker Outlet Boxes	24" floor to center of box
Janitor's Sink Faucet Fittings	42" floor to centerline
Hose Bibbs	36" AFF to centerline
Non Freeze Wall Hydrant	18" AFG to centerline

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SECTION 15010 (230010) - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the

opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
CEC	California Energy Code
CMC	California Mechanical Code
UBC	Uniform Building Code
UPC	Uniform Plumbing Code
IBC	International Building Code
IPC	International Plumbing Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

- 1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."

2. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
 3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use. When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
 - 4.
 5. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
 6. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
 7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 8. CMATT: Certified Acceptance Mechanical Test Technician. A professional certified to perform acceptance tests and complete the documentation required for nonresidential acceptance tests as required by the California Building Energy Efficiency Standards. Technician shall be certified by an authorized mechanical acceptance test technician certification provider.
 9. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 10. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 11. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. Bedding: Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
 3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.

5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate the work with other contractors and subcontractors so that various components of the mechanical systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use

elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

- C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. Provide the number of submittals required by Division 01; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- F. Refer to individual Sections for additional submittal requirements.
- G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- I. Submittals shall contain the following information:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. Equipment identification acronym as used on the drawings.
 - 4. The submittal date.
 - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 - 6. Submittals not so identified will be returned to the Contractor without action.
- J. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.
- L. Provide welders' qualification certificates.

1.8 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
 - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
 - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 - 2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
 - 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in each individual Section.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representative.

1.11 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

1.12 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

- A. Exposed ductwork and ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Contractor using materials and methods as specified under Division 09 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of their own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.17 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with

service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.

1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.18 PROJECT CONDITIONS

A. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 NOT USED

A. -

PART 3 - EXECUTION

3.1 PERMITS

A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 ACCEPTANCE TESTING REQUIREMENTS

A. Perform acceptance test procedures in accordance with the specifications listed in the Reference Joint Appendices for the Building Energy Efficiency Standards of California. Reference the Non-Residential Certificate of Compliance (NRCC) forms on the drawings for the systems which shall be tested.

B. Submit Non-Residential Certificate of Acceptance (NRCA) forms for each system for which the CMATT is responsible.

3.3 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.4 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation and Trenching shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations and trenches for safety. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations and trenches to comply with Geotechnical Report, local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations and trenches regardless of time period excavations and trenches will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering of Excavation and Trenches: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
 - 1. Do not allow water to accumulate in excavation or trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations and trenches.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas.

3. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
1. Locate and retain soil materials away from edge of excavations and trenches. Do not store within drip-line of trees indicated to remain.
 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
 2. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of sand or pea gravel prior to installation of pipe. Provide a minimum of 6 inches of sand or pea gravel cushion between rock bearing surface and pipe.
 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment bedding on undisturbed soil.
- M. Cold Weather Protection: Protect excavation and trench bottoms against freezing when atmospheric temperature is less than 35°F.

3.5 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.6 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.7 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
 - 1. Submit complete Operation and Maintenance Manuals.
 - 2. Submit complete Record Drawings.
 - 3. Perform special inspections as required in each individual Section.
 - 4. Start-up testing of systems.
 - 5. Removal of temporary facilities from the site.
 - 6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, the Contractor shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. The Contractor shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor Date Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative Date Company

Engineer Review and Recommendation Section

Recommend Acceptance Yes No
Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature Date Company

Owner Acceptance Signature Date Company

Architect Acceptance Signature Date Company

Engineer Acceptance Signature Date Company

SECTION 15030 (230015) - ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL" for specification of motor connections.
- C. Refer to Division 26, "ENCLOSED CONTROLLERS" for specification of motor starters.

- D. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN	SET	POWER CONTROL	
	BY	BY	WIRING	WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23t
Overload heaters DIV23m	DIV26	---	---	---
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Variable speed drives	DIV23m	DIV23m	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m	DIV26	DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Thermostats (low voltage)	DIV23t	DIV23t	---	DIV23t
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Time switches (for mechanical equipment)	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Temperature control panels (housing controllers)	DIV23t	DIV23t	DIV26	DIV23t
Building controllers, advanced application controllers, and application specific controllers	DIV23t	DIV23t	DIV23t	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t
Damper operators, PE & switches	DIV23t	DIV23t	DIV23t	DIV23t
Duct Smoke detectors	DIV28	DIV23m	DIV28	DIV28
Temporary heating connections	DIV23m	DIV23m	DIV26	DIV23m
Interlocks between air handling units and exhaust fans	---	---	---	DIV23m
Interlocks between HVAC fans and damper operators	---	---	DIV26	DIV23t

DIV23m = Mechanical Contractor
 DIV26 = Electrical Contractor
 DIV28 = Electronic Safety and Security

DIV23t = Temperature Controls Sub-Contractor

END OF SECTION

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SECTION 15050 (230500) - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.
 2. Mechanical equipment nameplate data.
 3. Concrete for bases and housekeeping pads.
 4. Non-shrink grout for equipment installations.
 5. Sleeves for mechanical penetrations.
 6. Drip Pans.
 7. Miscellaneous metals for support of mechanical materials and equipment.
 8. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
 9. Joint sealers for sealing around mechanical materials and equipment.
 10. Sealing penetrations through noise critical spaces.
 11. Firestopping
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 07 Section "Penetration Firestopping" for material and methods for firestopping systems.
 2. Division 23 Section "Basic Piping Materials and Methods," for materials and methods for mechanical sleeve seals.
 3. Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system of leak detection system "Water Present" alarm.
 4. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 23 Section General Mechanical Requirements.
1. Product data for the following products:
 - a. Access panels and doors.
 - b. Joint sealers.
 - c. Through and membrane-penetration firestopping systems.
 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
 4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.4 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

<u>Space</u>	<u>RC Levels</u>
A/V Spaces	25
Meeting/Banquet Rooms	30
Conference Rooms	30

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. Manufacturers:
 1. Bar-Co., Inc.
 2. Elmdor Stoneman.
 3. JL Industries
 4. Jay R. Smith Mfg. Co.
 5. Karp Associates, Inc.
 6. Milcor

7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:

1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
2. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
3. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
4. Locking Devices: Flush, screwdriver-operated cam locks.

2.2 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted mechanical equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have height as specified on the drawings or minimum height if not specified in accordance with the following table:

Equipment	Minimum Height
Furnaces, Exterior Equipment Less than or equal to 20 tons and Other Equipment Not Listed	3-1/2"

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.5 PENETRATIONS

- A. Sleeves:
 1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
 2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.6 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.7 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB

rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.8 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Nonacid Curing Sealer: One-part, nonacid-curing, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - 1. Manufacturers:
 - a. Dow Corning, Dowsil 790.
 - b. Dow Corning, Dowsil 795.
 - c. GE, Silglaze II SCS 2350.
 - d. GE, Silpruf SCS 2000.
 - e. Owens Corning, Energy Complete.
 - f. Pecora, 864 NST.
 - g. Tremco, Spectrem 1.
 - h. Tremco, Spectrem 2.
- D. High Humidity Sealer: One-part, mildew-resistant, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 1. Manufacturers:
 - a. Dow Corning, Dowsil 786.
 - b. GE, Momentum SCS1700.
 - c. Pecora, 898 Silicone NST.
- E. Hybrid Joint Sealer: One-part, non-sag, paintable complying with ASTM C920, Type S, Grade NS, Class 50, recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent.
 - 1. Manufacturers:
 - a. BASF, MasterSeal NP 100.
 - b. Pecora, DyanTrol I-XL.
 - c. Tremco, Dymonic FC.
- F. Acrylic Latex Joint Sealer: One-part, non-sag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C834, Type OP, Grade NF, recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 - 1. Manufacturers:
 - a. Pecora, AC-20
 - b. Sherwin Williams 950A
 - c. Tremco, Tremflex 834

2.9 ACOUSTICAL SEALANTS

- A. General: Penetrations by ducts, pipes and conduit through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m³).
- E. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90. Meeting ASTM E84 for a smoke flame spread index of less than 25 / 50.
- F. Manufacturers:
 - 1. Pecora, AC-20 FTR.
 - 2. Pecora, AIS-919.
 - 3. USG, SHEETROCK Acoustical Sealant.

2.10 FIRESTOPPING

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E814, or other NRTL acceptable to AHJ.
- B. Manufacturers:
 - 1. 3M Corp., Fire Barrier Sealant.
 - 2. Hilti.
 - 3. Owens Corning, Firestopping Insulation.
 - 4. Pecora, AC-20 FTR.
 - 5. RectorSeal.
 - 6. Specified Technologies Inc., Firestop.
 - 7. USG SHEETROCK Firecode Compound.
 - 8. Tremco, Tremstop Fyre-Sil.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.

3.2 INSTALLATION OF ACCESS DOORS

- A. Provide access doors for all concealed equipment and duct and piping accessories that require service where indicated or as required, except where above lay-in ceilings. Refer to Section "Identification for HVAC Piping and Equipment" for labeling of access doors.
- B. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
- C. Access doors must be of the proper construction for type of construction where installed.
- D. The exact location of all access doors shall be verified with the Architect prior to installation.
- E. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- F. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

A. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

G. All sleeves shall be of ample size to allow for movement of conduit, duct or pipe and insulation through the sleeves without damage to the insulation.

H. Cut sleeves to length for mounting flush with both surfaces of walls.

I. Extend sleeves installed in floors 2 inches above finished floor level.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

K. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

L. All circular and oval openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 23 Section "Basic Piping Materials and Methods". All rectangular openings through underground exterior walls shall be flanged and flashed with non-corrosive material on each side and the gap sealed with weatherproof sealant.

3.8 DRIP PANS

- A. Provide drip pans in locations indicated on drawings.
- B. Provide drip pans under piping or equipment that is installed in spaces that have sensitive electronics/electrical equipment such as electrical, IT/AV, telecom, data equipment, elevator machinery rooms, etc. Obtain approval from the Architect prior to installation.
- C. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.
- D. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.
- E. Provide drip pan supports every 4'-0".

3.9 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of Sheet Metal or piping with shaft walls, floor slabs and/or partitions. All openings around pipes and ducts in the structure surrounding the mechanical equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein.. This includes all slab penetrations and penetrations of noise critical walls.
- B. Duct Penetrations: Where each duct passes through a wall, floor or ceiling of a noise critical space, there shall be a clear annular space of 1 inch between the duct and structure. After all of the ductwork is installed, the Contractor shall check the clearance, pack the voids full depth with packing material and caulk both ends with non-hardening sealant backed by foam rod or permanently flexible firestop material. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.
- C. HVAC Piping:
 - 1. Provide a steel sleeve cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, verify the specified clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.
 - 2. Provide factory fabricated split seal clamp around the pipe filled with closed-cell neoprene sponge insulation, thickness as required to match adjacent insulation, minimum 3/4 inch. Cast or grout the sleeve into the structure. Provide fiberglass insulation if the pipe is subject to temperatures greater than 225 degrees F. Provide Mason Industries Type SWS or approved equal.

END OF SECTION

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SECTION 15055 (230510) - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. Joining materials.
- B. Escutcheons.
- C. Mechanical sleeve seals.
- D. Pipe roof curbs.

1.2 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section “General Mechanical Requirements” for administrative and procedural requirements for submittals.
- B. Product Data, including, rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.
- C. Piping Schedule: Submit a piping schedule that states the material being proposed for each piping system application in the project including manufacturer’s catalog information, pipe materials, sizes, fittings, Type, Grade, Schedule, applicable ASTM standard, and connection method(s).
- D. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.
- E. Manufacturer's Installation Instructions: Indicate hanging and support methods and joining procedures.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- G. Shop Drawings: Include detailed fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
- H. Coordination Drawings: Include piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- I. As-built drawings for each piping system in electronic and PDF format.
- J. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.3 QUALITY ASSURANCE

- A. Comply with ASME B31.9 - Building Services Piping, most recent edition.
- B. Soldering and Brazing procedures shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration.

- C. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ASME, and ANSI standards.
- D. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- C. Refer to the individual piping system specification sections in Division 23 for additional requirements.

PART 2 - PRODUCTS AND MATERIALS

2.1 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 Piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Brazing Filler Metals: Comply with SFA-5.8, Section II, ASME BPVC for brazing filler metal materials appropriate for the materials being joined.
 - 1. AWS A5.8, Classification BAg-5:
 - a. Silver (Ag) 44.0 – 46.0 percent.
 - b. Zinc (Z) 23.0 – 27.0 percent.
 - c. Copper (Cu) 29.0 – 31.0 percent.
 - 2. AWS A5.8, Classification BCuP-5:
 - a. Phosphorus (P) 4.8 - 5.2 percent.
 - b. Silver (Ag) 14.5 - 15.5 percent.
 - c. Copper (Cu) remainder.
- D. Soldering Filler Metals: ASTM B32, 95-5 Tin-Antimony and water flushable flux in accordance with ASTM B813.

2.3 ESCUTCHEONS

- A. Manufacturers:
 - 1. AWI Manufacturing.
 - 2. Keeney Manufacturing Company.
 - 3. Wal-Rich Corp.
 - 4. Jones Stephens Corp.
 - 5. Approved equal.
- B. Chrome-plated, stamped-steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

2.4 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline/Link Seal.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Approved equal.
- B. Sleeves: Refer to Division 23 Section “Common Work Results for HVAC” for sleeve materials.
- C. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 PIPE ROOF CURBS

- A. Manufacturers:
 - 1. AES Industries.
 - 2. Custom Curb, Inc.
 - 3. Pate Company.
 - 4. Thybar.
- B. Provide factory-fabricated, pipe roof curbs with the following features:
 - 1. Factory installed treated wood nailer.
 - 2. Welded, 18 gauge galvanized steel shell, base plate and flashing.
 - 3. 1-1/2 inch thick, 3 pound rigid insulation.
 - 4. Fully mitered 3-inch raised cant.
 - 5. Cover of weather-resistant, weather-proof material.
 - 6. Pipe collar of weather-resistant material with stainless steel pipe clamps.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer’s instructions.
- B. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- C. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- D. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

- E. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- F. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
- J. Verify final equipment locations for roughing in.
- K. Use fittings for all changes in direction and all branch connections.
- L. Remake leaking joints using new materials.
- M. Install components with pressure rating equal to or greater than system operating pressure.
- N. Piping Protection:
 - 1. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
 - 2. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.3 PENETRATIONS

- A. Mechanical penetrations occur when piping or ductwork penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies. Reference Division 23 Section "Common Work Results for HVAC" for additional penetration requirements.
- B. Above Grade Concrete or Masonry Penetrations:
 - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs.
 - a. Provide Schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
 - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
 - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
 - 2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.

3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant.

C. Above Ground, Exterior Wall Penetrations:

1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2 inch of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.

D. Interior Penetrations of Non-Fire-Rated Walls:

1. Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of 1/2 inch of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
2. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1 inch annular clear space between inside of sleeve and outside of insulation.

E. Acoustical Barrier Penetrations:

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Common Work Results for HVAC" for noise critical spaces. The internal diameter of the sleeve shall be minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
2. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.4 PIPE JOINT CONSTRUCTION

A. Brazed and Soldered Joints:

1. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
2. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
3. **WARNING:** Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
4. **CAUTION:** Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
 1. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making joint.
 2. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
 5. Copper-to-copper joints shall be made using BCuP-5 brazing filler metal without flux.
 6. Dissimilar metals such as copper and brass shall be jointed using an appropriate flux with either BCuP-5 or BAg-5 brazing filler metal. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside the completed joint.
 7. Continuously purge the pipe and fittings during brazing with an inert gas (i.e., dry nitrogen or carbon dioxide) to prevent formation of scale. Maintain purge until the joint is cool to the touch.
 8. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
 9. Provide temporary cap or cover on completed joints with open ends to prevent entry of contaminating materials.

B. Mechanical Refrigerant Pipe Joints: Flared compression fittings may be used for refrigerant lines 3/4 inch and smaller.

3.5 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.

END OF SECTION

SECTION 15170 (230513) - COMMON MOTOR REQUIREMENT FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).
- F. Capacitors.

1.2 REFERENCE STANDARDS

- A. ABMA STD 9 – Load Ratings and Fatigue Life for Ball Bearings; most recent edition.
- B. IEEE 112 – IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; most recent edition.
- C. NEMA MG 1 – Motors and Generators; most recent edition.
- D. NFPA 70 – National Electrical Code; most recent edition adopted by the Authority Having Jurisdiction, including all applicable amendments and supplements.

1.3 SUBMITTALS

- A. Conform with the submittal procedures in Division 01.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements. Provide nameplate data and ratings, mounting arrangements, size and location of winding termination lugs, overload relays, conduit entry, grounding lug, and coatings.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.

- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY STORAGE AND HANDLING.

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6 WARRANTY

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Baldor Electric Company.
- B. General Electric.
- C. Gould.
- D. Marathon.
- E. Regal-Beloit Corporation (Century).
- F. Westinghouse

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors 3/4 HP and Larger: Voltage as scheduled, three phase, 60 Hz.
- B. Construction:
 - 1. Open drip-proof except where noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- C. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

2.3 APPLICATIONS

- A. Exception: Motors less than 250 Watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- C. Single phase motors for fans, pumps, blowers and air compressors: Capacitor start type.
- D. Single phase motors for fans less than 1 hp and greater than 1/12 hp: Electronically commutated type.
- E. Motors located in exterior locations, air cooled condensers: Totally enclosed fan cooled type.
- F. Motors located outdoors in wet airstreams, including but not limited to cooling towers, evaporative condensers, and sprayed coils: Totally enclosed weatherproof epoxy-sealed type.

2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

- E. Insulation System: NEMA Class B or better.
- F. Drip-proof Enclosure: NEMA Service Factor.
- G. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.
- H. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- I. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- J. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 26 - Motor Controlling Equipment.
- K. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- L. Sound Power Levels: To NEMA MG 1.
- M. All totally enclosed motors shall be fan cooled type. Non-ventilated type motors are not acceptable.
- N. Motors controlled by variable frequency drives:
 - 1. Rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.
 - 2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 3. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
 - 4. Grounding: Provide shaft grounding system equal to AEGIS SGR Bearing Protection Ring, Inpro/Seal Current Diverter Ring (CDR) or approved equal. Install system in accordance with manufacturer's recommendations.
 - 5. Motor Overload Relay: When a single drive is used to supply power to multiple motors, provide a solid state 3-phase adjustable overload relay between the drive and each motor.
 - a. Relay shall have manual reset.
 - b. Provide alarm contact with automatic reset overloads.
- O. Part Winding Start, Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- P. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- Q. Nominal Efficiency: Motors shall have minimum NEMA premium efficiency at full load and rated voltage when tested in accordance with IEEE 112.
- R. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

2.7 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Minimum efficiency: 70 percent when rated in accordance with NEMA Standard MG 1 at full load rating conditions.
- B. Motor shall be permanently lubricated with heavy-duty ball bearings to match the equipment load and prewired to the specific voltage and phase.
- C. Internal motor circuitry shall convert AC power supplied to the equipment to DC power to operate the motor.
- D. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal.

2.8 CAPACITORS

- A. Furnish capacitors for power factor correction as specified herein on motors furnished under Division 23 that are not connected to variable frequency drives. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.
- B. Features:
 - 1. Individual unit cells.
 - 2. All welded steel housing.
 - 3. Each capacitor internally fused.
 - 4. Non-flammable synthetic liquid impregnated.
 - 5. Craft tissue insulation.
 - 6. Aluminum foil electrodes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install securely on firm foundation.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Install motor overload relays in a common enclosure adjacent to the variable frequency drive

3.2 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

3.3 PERFORMANCE SCHEDULE: THREE PHASE - OPEN DRIP-PROOF

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	84	73
2	1200	184T	85.5	75
3	1200	213T	86.5	60
5	1200	215T	87.5	65
7-1/2	1200	254T	88.5	73
10	1200	256T	90.2	74
15	1200	284T	90.2	77
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86.5	86
5	1800	184T	87.5	87
7-1/2	1800	213T	88.5	86
10	1800	215T	89.5	85
15	1800	256T	91	85
1-1/2	3600	143T	82.5	85
2	3600	145T	84	87
3	3600	145T	84	85
5	3600	182T	85.5	86
7-1/2	3600	184T	87.5	88
10	3600	213T	88.5	86
15	3600	215T	89.5	89

3.4 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
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1	1200	145T	80	72
1-1/2	1200	182T	85.5	65
2	1200	184T	86.5	68
3	1200	213T	87.5	63
5	1200	215T	87.5	66
7-1/2	1200	254T	89.5	68
10	1200	256T	89.5	75
15	1200	284T	90.2	72
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87.5	83
5	1800	184T	87.5	83
7-1/2	1800	213T	89.5	85
10	1800	215T	89.5	84
15	1800	254T	91	86

END OF SECTION

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SECTION 15140 (230529) - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.
- B. Horizontal piping hangers and supports.
- C. Saddles and shields.
- D. Vertical piping clamps.
- E. Pre-engineered roof pipe supports.
- F. Pre-engineered roof equipment supports.
- G. Anchors and fasteners.
- H. Miscellaneous materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

- D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."
- E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
 - 1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

1.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with MSS SP-58.
 - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Carbon steel, galvanized steel, zinc-plated steel or approved equivalent where installed for piping and equipment that will not have a factory-applied or field-applied finish, unless otherwise indicated.
 - b. Outdoor Locations: Type 304 stainless steel, galvanized steel, aluminum, or approved equivalent.
 - c. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
 - d. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - e. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - f. Stainless Steel: Type 304 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:

1. Manufacturers:
 - a. Cooper B-Line.
 - b. Ferguson Enterprises/FNW.
 - c. PHD Manufacturing.
 - d. Thomas & Betts Corporation.
 - e. Unistrut, a brand of Atkore International Inc.
 - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-69, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.
4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor Locations: Use stainless steel, aluminum, or galvanized steel.
 - c. All nuts, brackets, and clamps shall have the same finish as the channel.
5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

C. Hanger Rods:

1. Threaded zinc-plated steel, threaded both ends or continuously threaded, unless otherwise indicated.
2. Minimum Size: Reference piping specification sections for rod thicknesses.
3. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

D. Wire Rope Pipe Hanging Systems:

1. Manufacturers:
 - a. Anvil International.
 - b. Gripple.
2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.

4. Cast-in-place Concrete Insert: Pressed steel body with sintered steel wedge, 302 stainless steel spring and UV stabilized homopolymer polypropylene end cap. Model: Gripple Spider Hanging Kit.
5. Cable Stud: Carbon steel, zinc-coated, designed for attachment to concrete inserts. Model: Anvil C120.
6. Cable Coupling: Carbon steel, zinc-coated, designed for attachment to threaded rods. Model: Anvil C130.
7. Cable Eyelet: Carbon steel, zinc-coated, designed to be directly attached to structural supports via anchors or fasteners. Model: Anvil C150.
8. Cable Toggle: Carbon steel, zinc-coated, with toggle designed for insertion into 1/2 inch hole through steel deck hat channel and provides anchor when pulled in tension. Model: Anvil C150.
9. Swivel Toggle Insert: Single assembly attached to wire rope cable, manufactured from plated carbon steel toggle, pins, and shackles; swivel insert engineered to be compatible with concrete insert.
10. Wire Rope: High tensile steel wire rope, to ASTM A1023, Class A zinc coating; minimum 7 by 7 cross-sectional thread construction; having a tensile strength of 256,000 psi; No.3 wire size minimum.
11. Adjustable Fastener: Mild steel (type UG2), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 500 lb. Model: Gripple No. 2, 3 or 4 UniGrip.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Manufacturers:

1. Armacell.
2. Anvil International.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy
6. Ferguson/FNW.
7. Halfen-DEHA.
8. Hilti.
9. National Pipe Hanger Corporation.
10. PHD Manufacturing.
11. Power-Strut.
12. Unistrut.

B. Single Hangers:

1. Band Hanger: Carbon steel, adjustable band, adjustable swivel.
2. Split Ring: Carbon steel, adjustable swivel, split ring type.
3. Clevis Hanger: Carbon steel, adjustable, clevis type.
4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

C. Trapeze and Strut-mounted Supports:

1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.

D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:

1. Manufacturers:
 - a. Anvil International.
 - b. Holdrite.
 - c. Klo-Shure.

2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.

E. Spring Hangers:

1. Reference Section “Vibration Isolation for HVAC Piping and Equipment” for spring isolation hangers.

F. Wall Supports:

1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.

G. Floor and space lid Supports:

1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

H. Pre-Insulated Supports:

1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell.
 - c. Buckaroos, Inc.
 - d. Cooper B-Line, Inc.
2. General Construction and Requirements:
 - a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
 - b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Waterproof calcium silicate insulation shall conform to ASTM C795.
 - d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
 - e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.3 SADDLES AND SHIELDS

A. Pipe Covering Protection Saddles:

1. Manufacturers: Same as hanger and Supports.
2. Meet MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12 inches and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12 inches long.

B. Insulation Protection Shield:

1. Sheet metal construction, meeting MSS SP-58 Type 40, of 18 gauge for 5-1/2 inches inside dimension and smaller, 16 gauge for 6-1/2 inches to 10-3/4 inches inside dimension, 14 gauge for 11-3/4 inches to 17 inches inside dimension, and 12 gauge for 18 inches to 28 inches inside dimension.
2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.

4. For pipes 2 inch and smaller without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in)					
		5	6	7	8	9	10
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
≤ 2	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

C. 360 Degree Insulation Protection Shield:

1. Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

D. Plastic Saddles and Shields:

1. Manufacturers:
 - a. Armacell.
 - b. Eaton.
 - c. Hydra-Zorb.
 - d. PHD Manufacturing.
 - e. Zsi Foster.
2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.4 VERTICAL-PIPING SUPPORTS

A. Manufacturers:

1. Armacell.
2. Anvil International.
3. Cooper B-Line, Inc.
4. Halfen-DEHA.
5. Hilti.
6. ERICO/Michigan Hanger Co.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing.
9. Power-Strut.
10. Unistrut.

B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.

C. Riser Clamps with pre-manufactured polymer insert:

1. Manufacturers:
 - a. Hydra-Zorb; Titan Riser Clamp.
 - b. National Pipe Hanger.
 - c. Approved equal.
2. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.5 PRE-ENGINEERED ROOF PIPE SUPPORTS

- A. Manufacturers:
 1. Airtec.
 2. Anvil International.
 3. Cooper B-Line, Inc.
 4. Elite Components.
 5. ERICO/Michigan Hanger Co./Caddy.
 6. Ferguson/FNW.
 7. Miro.
 8. PHP Systems/Design.
 9. PHD Manufacturing.
 10. Roof Top Blox.
 11. Unistrut, a brand of Atkore International Inc.
 12. Zsi Foster.
- B. General: Pre-engineered devices with embedded pipe support fixtures as specified.
- C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
 1. Up to 12 inch strut length support: 18 inch x 18 inch.
 2. Up to 16 inch strut length support: 24 inch x 18 inch.
 3. Up to 24 inch strut length support: 30 inch x 18 inch.
 4. Thickness: Minimum 3/16 inch thick.
- D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
 1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
 2. Width: Nominal 4 inches.
- E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.6 PRE-ENGINEERED ROOF EQUIPMENT SUPPORTS

- A. Reference Section "Vibration Isolation for HVAC" for vibration isolated pre-engineered roof equipment supports.
- B. Manufacturers: Subject to compliance with requirements, provide roof equipment supports from the equipment manufacturer or from one of the following:
 1. AES Industries.
 2. Caldyn, California Dynamics Corp.
 3. Custom Curb, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries, Inc.

6. Pate Company.
7. Thybar.
8. Vibration Eliminator Co., Inc.
9. Vibration Mounting and Controls (VMC Group).
10. Vibro-Acoustics.

C. Single Rail Equipment Supports:

1. Construction:
 - a. Base plate with fully mitered raised cant and step to match roof insulation thickness.
 - b. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
 - c. Factory installed treated wood nailer.
 - d. 4 inch, minimum 18 gauge nailer jacket with counterflashing where equipment will not fully cover the equipment support.

D. Roof Curbs:

1. Construction:
 - a. Comply with NRCA standards.
 - b. Base plate with fully mitered raised cant and step to match roof insulation thickness.
 - c. Welded, minimum 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
 - d. Minimum 1-1/2 inch thick, 3 pound density rigid insulation internal to shell to maintain continuous roof insulation.
 - e. Factory installed treated wood nailer and drain nipple.
 - f. Sloped to match roof structure to enable level installation.

2.7 ANCHORS AND FASTENERS

A. Manufacturers:

1. Hilti, Inc.
2. Illinois Tool Works, Inc.
3. Phillips.
4. Powers Fasteners, Inc.
5. Rawl.
6. Simpson Strong-Tie Company Inc.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

1. Concrete: Use preset concrete inserts or expansion anchors.
2. Solid or Grout-Filled Masonry: Use expansion anchors.
3. Hollow Masonry: Use toggle bolts.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.

C. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

1. Comply with MFMA-4.

2. Channel Material: Use galvanized steel.
 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
 4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
 5. Manufacturers:
 - a. Same as manufacturer of metal channel (strut) framing system.
 - b. DeWalt “Bang-It” concrete inserts.
- D. Post-Installed Concrete and Masonry Expansion Anchors:
1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.
- E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 1. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- F. Vibration Isolation Anchors: Reference Section “Vibration Isolation for HVAC Piping and Equipment” for vibration isolation anchors.
- 2.8 MISCELLANEOUS MATERIALS
- A. Steel Plates, Shapes, and Bars: ASTM A 36.
 - B. Malleable Iron: ASTM A47
 - C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer’s instructions.
- B. Provide hangers and supports according to the Pipe Hanger and Support Schedule below.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 23 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 4. Refer to Section 230700 for definition of hot and cold piping and required insulation thickness.
- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 23 piping sections.
 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 23 Section "HVAC Insulation".
- I. Install building attachments within concrete or to structural steel.
 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections.
 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

- K. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
 - 1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 Section "HVAC Insulation".
 - 2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 23 Section "HVAC Insulation". Do not use polymer-based shields for hot piping.
 - a. Exception for horizontal cold piping with fiberglass, cellular glass, flexible elastomeric, or polyisocyanurate insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.
 - 4. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
 - 5. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - 1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - 2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 23 Section "HVAC Insulation".
- P. Vertical Piping Risers:
 - 1. Reference Section "Vibration Isolation for HVAC Piping and Equipment" for piping riser supports.
- Q. Wire Rope Hanging Systems:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Supported load shall not exceed manufacturer's recommended load rating.
 - 3. Applications for Pipe Supports:
 - a. 3 inch and smaller.
 - b. Wire rope hanging system is not allowed for steam or steam condensate piping.
 - 4. Do not support pipe by wrapping the rope around the pipe.
 - 5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in the Pipe Hanger and Support Schedule.
 - 6. Install cast-in-place concrete inserts in elevated concrete slabs.
 - 7. Install bream clamps for attachment to structural beams as required.

3.4 INSTALLATION OF PRE-ENGINEERED ROOF PIPE SUPPORTS

- A. Install pre-engineered roof pipe supports to rest on the roofing membrane without attachment to the roof structure or penetration through the roofing assembly.
- B. Install pre-engineered roof pipe supports anchored to the roof structure.
 - 1. Install supports to meet the specified design criteria.
 - a. Building Design Risk Category: II.
 - 2. Coordinate with the pre-engineered roof pipe support manufacturer to anchor the pipe supports directly to the roof structure in accordance with the manufacturer's installation instructions or provide intermediate pipe supports engineered to meet the design criteria.
 - 3. Submit design and installation requirements as a Deferred Submittal.
- C. Refer to Section "Seismic Controls for Mechanical" for seismic bracing requirements.

3.5 INSTALLATION OF ROOF EQUIPMENT SUPPORTS

- A. Attach roof equipment support to the roof structure according to the manufacturer's installation instructions.
- B. Provide multiple single rail equipment supports to uniformly support the equipment.
- C. Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope.
- D. Install supports to maintain continuous insulation on roof.
- E. Provide vibration isolators between roof equipment support and equipment according to Division 23 Section "Vibration Isolation for HVAC."
- F. If vibration isolation is not required or units are internally isolated, attach equipment directly to pre-engineered roof equipment support using one of the following:
 - 1. Single Rail Equipment Supports: Secure each equipment support leg to the rail with a minimum of 4 points of connection per leg.
 - 2. Roof Curbs:
 - a. Secure each corner of the equipment to the curb nailer using a minimum of 4 lag screws, located along the length of the equipment.
 - b. Secure equipment to the curb using hold-down brackets. Provide minimum 6 inch long, 14 gauge galvanized steel brackets sized to wrap around top of curb and under equipment base rail with sufficient horizontal offset to cover overlap gap between the equipment rail and curb. Secure bracket to equipment and curb nailer using a minimum of 8 points of connection per bracket. Provide one bracket at each corner along the length of the unit.
- G. Refer to Section "Seismic Controls for Mechanical" for seismic bracing requirements.

3.6 EQUIPMENT SUPPORT AND ATTACHMENT

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.
- I. Grouting: Place grout under supports for piping and equipment.

3.7 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.8 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

3.9 PIPE HANGER AND SUPPORT SCHEDULE

- A. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- B. Single Hangers:
 - 1. All pipe sizes 1-1/2 inch and less:
 - a. Band hanger.
 - b. Swivel split ring.
 - c. Clevis hanger.
 - 2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
 - 3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
- C. Trapezes and Strut-mounted Supports:
 - 1. All pipe sizes less than 6 inches: Two-piece clamp.
 - 2. Pipe sizes 6 inches and greater: Roll support.
- D. Wall Supports:
 - 1. Pipe sizes 3 inches and less:
 - a. Two-hole strap mounted to wall.
 - b. Welded steel bracket with reinforced angle or strut.
 - 2. Pipe sizes 4 inch and greater:
 - a. Welded steel bracket with reinforced angle or strut.
- E. Floor Supports:
 - 1. Pipe sizes 4 inch and less: Pipe saddle.
 - 2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION

SECTION 15520 (230548) - SEISMIC CONTROLS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 20 Section "Seismic Controls for MEP/F/T Systems" for general requirement and related documents that apply to this section.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 SUMMARY

- A. Seismic bracing, restraints, and controls for all mechanical systems specified herein shall be designed and installed as required by Division 20 Section "Seismic Controls for MEP/F/T Systems".

1.5 SUBMITTALS

- A. Provide submittals as required by Division 20 Section "Seismic Controls for MEP/F/T Systems" for all mechanical systems specified herein.

PART 2 - PRODUCTS AND MATERIALS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

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SECTION 15200 (230550) - VIBRATION ISOLATION FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.2 COORDINATION

A. Contractor's Responsibility:

1. Verify the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.
2. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.
3. Coordinate selection and arrangement of vibration isolation components with the actual equipment to be installed.
4. Coordinate the work with other trades to provide additional framing and materials required for installation.
5. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
6. Sequencing:
 - a. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

B. Manufacturer's Responsibility:

1. Determine vibration isolation types for all equipment and systems in accordance with the local governing code.
2. Calculate the static deflection requirements for all equipment and systems to provide uniform deflection based on distributed operating weight of actual installed equipment.
3. Select the vibration isolation systems to provide static deflection indicated on the Vibration Isolation Schedule and as specified below. Determine the mounting sizes and layout.
4. Guarantee specified isolation system deflection.
5. Provide installation instructions, drawings and field supervision to ensure proper installation and performance.
6. Verify that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities. Include clearly outlined procedures for installing and adjusting the isolators.
- B. Shop Drawings:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators on each piece of isolated equipment. Indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable. Indicate equipment mounting provisions.
 - 3. Piping isolators shown and identified on piping layout drawings.
 - 4. Concrete foundations, supports, and required reinforcing and forms. These appurtenances shall be provided by another trade. This trade shall furnish the shop drawings, including the following:
 - a. Concrete reinforcing steel details and templates for all foundations and supports.
 - b. Required hanger bolts.
 - c. All other appurtenances necessary for proper installation of equipment.
- C. Vibration Isolation System Schedule: Include the following for each isolation element:
 - 1. Manufacturer, isolator type, model number, size.
 - 2. Height when uncompressed and static deflection.
 - 3. Spring constant.
 - 4. Spring outside diameter, free operating, and solid heights.
 - 5. Design of supplementary bases.
 - 6. Details of attachment to load-bearing structure or supplementary framing.
- D. Post-Installation Inspection Report:
 - 1. Vibration isolation vendor notice of inspection of all vibration isolators.
 - 2. Vibration isolation vendor notice of approval that all vibration isolators have been properly installed and conform to the specification.
 - 3. Itemized list of deficiencies.
 - 4. Vibration Isolation System Schedule.
 - 5. For each isolator containing steel springs, record the following:
 - a. Size.
 - b. Uncompressed height.
 - c. Design static deflection.
 - d. Measured static deflection.

1.4 QUALITY ASSURANCE

- A. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.
- B. All vibration isolation equipment and materials shall be new and manufactured specifically for the purpose intended.
- C. Maintain at the project site a copy of each reference document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. BRD Noise and Vibration Control.
- B. Caldyn, California Dynamics Corp.
- C. Kinetics Noise Control.
- D. Mason Industries, Inc.
- E. Vibration Eliminator Co., Inc.
- F. Vibration Mounting and Controls.
- G. Vibro-Acoustics.

2.2 VIBRATION ISOLATION REQUIREMENTS

- A. Construct vibration isolators out of resilient materials resistant to oil, ozone, and oxidant.
- B. Select vibration isolators to provide the static deflection as specified in Part 2 "Products" unless otherwise specified for the application listed in Part 3 "Execution."
- C. Where a pipe run connects multiple equipment, select the pipe isolators for the entire run to suit the connected equipment of greatest static deflection.
- D. Vibration isolators shall have either known undeflected heights or calibration markings so that the amount of deflection can be verified after adjustment to determine that the load is within the proper range of the device and that the correct degree of vibration isolation is provided according to the design.
- E. Vibration isolators shall provide uniform deflection and stability under all operating loads.
- F. Isolators for fans shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.
- G. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.
- H. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than plus/minus 10 percent.

- I. All elastomeric mountings shall have a Shore hardness of 30 to 60 plus/minus 5 after minimum aging of 20 days or corresponding over-aging, or as specified herein.
- J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated of natural rubber instead of neoprene.
- K. Equipment mounted on vibration isolated bases shall have minimum operating clearance of 1 inch between the base and floor or support beneath unless noted otherwise.
- L. Vibration Isolator Assemblies with Steel Springs:
 - 1. Housed or caged spring isolators are not acceptable.
 - 2. Assemblies shall use bare springs, color coded or otherwise identify springs to indicate load capacity.
 - 3. Spring diameter shall not be less than 0.8 of the loaded operating height of the spring.
 - 4. The ratio of the horizontal to vertical spring constant shall be between 1 and 2.
 - 5. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - 6. Assembly shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation.
 - 7. Springs shall operate in the linear portion of their load versus deflection curve over a deflection range of not less than 50 percent above the design deflection.

2.3 VIBRATION ISOLATED EQUIPMENT SUPPORT BASES

- A. Pre-Engineered Roof Equipment Support (Type RES):
 - 1. Reference Section “Hangers and Supports for HVAC Piping and Equipment” for specification of non-vibration isolated, pre-engineered roof equipment supports.
- B. Structural Rails (Type SR):
 - 1. Assembly: Structural steel channels furnished with double-deflection neoprene mountings or spring isolators.
 - 2. Base: All metal mounting parts shall be covered with neoprene to avoid corrosion and metal-to-metal contact.
 - 3. Selection: Channel length and isolator type with deflection as required for proper isolation of equipment.
 - 4. Type SR: Mason Industries Type RND or approved equal.
- C. Vibration Isolation Roof Curb (Type CMB):
 - 1. Description: Engineered, structural steel frame mounted directly to the structure with an upper floating section on adjustable steel springs. The upper frame shall provide continuous support for the equipment.
 - 2. Steel springs shall rest on minimum 1/4 inch thick elastomeric pads and have a minimum static deflection of 2 inches.
 - 3. All-directional elastomeric snubber bushings shall be minimum 1/4 inch thick.
 - 4. Weatherproofing: Continuous galvanized flexible counterflashing nailed over the lower curb’s waterproofing and joined at the corners by elastomeric bellows.
 - 5. Access Ports: Provided for all spring locations with removable waterproof covers to allow for adjustment or replacement of springs.
 - 6. Lower curbs shall have provision for 2 inches insulation.
 - 7. Type CMB: Mason Industries Type RSC or approved equal.

2.4 VIBRATION ISOLATORS

- A. Ribbed Neoprene “Waffle” Pads (Type WP):
1. Assembly: Single ribbed or crossed double ribbed elastomer in-shear pads, in one or more layers separated and bonded to a minimum 1/4 inch thick galvanized steel shim plate as required to provide selected deflection.
 2. Thickness: Each layer 5/16 inch thick.
 3. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.05 inches.
 4. Type WP: Mason Industries Type W, Type WSW, or approved equal.
- B. Constrained Steel Spring Neoprene Mounts (Type CSNM):
1. Assembly: Single or multiple free-standing and laterally stable steel springs assembled into a factory-fabricated housing with integral leveling device and stops to limit vertical movement of the isolated equipment during a temporary weight reduction. Include rigid blocking to support equipment during rigging to maintain identical installed and operating heights of the isolator. Housing shall maintain a minimum clearance of 1 inch around restraining bolts and the spring so as not to interfere with the spring operation.
 - a. Leveling Device: Rigidly connected to equipment or frame. Limit stops shall provide minimum 1/4 inch clearance between housing and isolator base plate under normal operation.
 - b. Equipment Wind Loading Applications: Provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene mounting sleeve.
 2. Base: Minimum 1/4 inch thick neoprene pad under housing.
 3. Selection: Minimum static deflection of 2 inches unless specified otherwise.
 4. Type CSNM: Mason Industries Type SLR or approved equal.
- C. Neoprene Bushing (Type NR):
1. Assembly: Neoprene restraint, rubber-in-shear bushings for lightweight, suspended equipment supported from structure with all-thread rod and angle iron or Unistrut.
 2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.15 inches.
 3. Type NR: Mason Industries Type HMIB or approved equal.
- D. Double Deflection Neoprene Hangers ((Type DDNH)
1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator . Neoprene isolator shall prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function.
 - a. Housing: Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
 2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches.
 3. Type DDNH: Mason Industries Type HD or approved equal.
- E. Spring and Neoprene Hanger (Type SPNH)
1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator in series with a steel spring.
 - a. Housing: Include a neoprene bushing to prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function. Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
 2. Selection:
 - a. Neoprene isolator: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches unless specified otherwise.
 - b. Spring isolator: Minimum static deflection of 2 inches unless specified otherwise.
 3. Type SPNH: Mason Industries Type 30N or approved equal.

- F. Neoprene Mounting Sleeves, Grommets, and Bushings: Designed to prevent steel-to-steel contact within vibration isolators.
- G. Flexible Connectors:
 - 1. Duct: Refer to Section “Air Duct Accessories.”

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive vibration isolation and associated attachments.

3.2 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer’s instructions.
- B. External spring isolators are not required if unit is provided with internal spring isolation. If external spring isolators are provided, internal spring isolation shall not be approved.
- C. Mount or suspend all equipment, piping, ductwork, etc. from approved foundations and supports as specified herein or as shown on the drawings.
- D. Secure fasteners according to manufacturer’s recommended torque settings.
- E. Support piping, ductwork, conduit, and mechanical equipment building structure. Do not support from other equipment, piping, or ductwork.
- F. Install isolators to prevent short-circuiting of the isolation.
- G. All wiring connections to mechanical equipment on isolators shall have a minimum 18 inch long flexible conduit in a “U” shaped loop. Coordinate with Division 26.
- H. Flexible Connectors: Install flexible connectors sized to match equipment connections and to provide sufficient slack for vibration isolation as required.
- I. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Block-up equipment with temporary shims to final operating height. When the system is assembled full load is applied, adjust the isolators shall be adjusted to allow shim removal.
- J. Refer to Division 23 Section “Seismic Controls for Mechanical” for seismic bracing requirements.
- K. Refer to Division 23 Section “Common Work Results for HVAC” for noise critical spaces.

3.3 INSTALLATION OF VIBRATION ISOLATED EQUIPMENT SUPPORT BASES

- A. All floor-mounted equipment shall be erected on housekeeping pads. Refer to Section “Common Work Results for HVAC” for concrete housekeeping pad requirements.

- B. Maintain minimum 4 inches clearance between isolated equipment and the walls, ceiling, floors, columns, and any other equipment not installed on vibration isolators.
- C. Set steel bases for one inch clearance between housekeeping pad and base.
- D. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
- E. Adjust equipment to be level.
- F. Verify no material is left to short-circuit the isolator.
- G. For equipment support bases installed on the roof, coordinate with the pre-engineered roof equipment support manufacturer to determine the quantity and size of hold-down brackets, isolators, and fasteners, with installation instructions, for each equipment to meet the following criteria:
 - 1. Building Design Risk Category: II].
 - 2. Design Wind Speed: 93 mph.
- H. Type CMB:
 - 1. Attach roof equipment support to the roof structure according to the manufacturer's installation instructions.
 - 2. Provide flexible duct connector using a foam rubber gasket to seal against the unit bottom.
 - 3. Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope on roof equipment support bases.
 - 4. Install roof equipment support bases to maintain continuous insulation on roof.

3.4 INSTALLATION OF VIBRATION ISOLATORS

- A. Neoprene Mounting Sleeves, Grommets, and Bushings: Install on vibration isolators to prevent any metal to metal contact.
- B. Spring Isolators:
 - 1. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
 - 2. Install springs so that the ends of springs remain parallel and all springs are installed with adjustment bolts.
 - 3. Locate isolation hangers at the top of hanger rods.
 - 4. Type SPNH and DDNH: Install the hanger box to allow it to rotate a full 360 degrees without encountering any obstruction.

3.5 EQUIPMENT ISOLATION

- A. Fan Coil Units Units:
 - 1. Units that are furnished with internal structural frames and external lugs (both of suitable strength and rigidity), or without any severe overhangs, do not require an additional structural frame installed beneath the unit.
 - 2. Support condensate drain pipes from the isolated air handling unit frame.
 - 3. Suspended: Type SPNH isolation with 2 inch static deflection.
- B. Packaged Rooftop Units:
 - 1. Roof-mounted, up to 20 ft span: Type CMB with 0.75 inch static deflection.
 - 2. Roof-mounted, span of 20 ft or more: Type CMB with 2 inch static deflection.
- C. Air-Cooled Condensers and Condensing Units:

1. Slab-on-Grade: Housekeeping pad base, Type WP isolation continuous along support.
2. Suspended Slab: Housekeeping pad base, Type CSNM isolation with 0.75 inch static deflection.
3. Roof-mounted: Type RES base, Type CSNM isolation with 2 inch static deflection.

D. VAV Terminal Units:

1. Fan-Powered: Flexible duct connectors with Type SPNH isolation with 1 inch static deflection.
2. All other Types: Flexible duct connectors.

E. Fans

1. Suspended:
 - a. Fans 1 hp and less: Type NR isolation with 0.15 inch static deflection.
 - b. Fans greater than 1 hp: Type SPNH isolation with 2 inch static deflection.
2. Roof-mounted:
 - a. Curb mounting: Type RES curb base, with closed cell sponge gasket for sealing, continuous along support sealed to curb top rail.
 - b. Rail mounting:
 - 1) Fans 10 hp and less: Type RES rail base, Type DDNM with 0.75 inch static deflection.
 - 2) Fans greater than 10 hp: Type RES rail base, Type SPNM with 2 inch static deflection.

F. Unit Heaters: Type SPNH isolation with 2 inch static deflection.

G. All other equipment not specifically identified in this specification that contains rotating or vibrating elements and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RNM neoprene isolators as appropriate.

3.6 PIPING ISOLATION

A. Provide isolation supports on the following HVAC pipe:

1. Piping within 50 feet of connected rotating equipment.
2. Piping installed below or adjacent to noise sensitive areas:
 - a. Refer to Section "Common Work Results for HVAC" for definition of noise sensitive areas.
 - b. In noise sensitive areas, isolate all 2 inch and smaller HVAC piping from the structure with sponge neoprene, felt, or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.

B. Pipes connected to equipment installed on spring vibration isolators: Type SPNM or SPNH.

1. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.

C. Provide resilient diagonal mountings or other approved devices as required to limit piping motion due to equipment startup or shut down to a maximum of 1/8 inch.

D. Vertical Piping Riser Supports:

1. Do not exceed pipe stresses allowed by ASME B31.9.
2. Provide multiple supports along riser so that each isolator support is loaded for 50 psi maximum. Provide tapped hole in top of support for rigid attachment of pipe riser clamp to support.
3. Riser Supports: Pipe clamp on top of Type DP or Type WP.
4. Risers Subject to Thermal Expansion:

- a. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators, anchors, and guides designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.
- b. Spring Isolators: Type SPNH, DDNH, or PRSA.

3.7 DUCT ISOLATION

- A. Connect ducts to equipment, fans, fan casings, and fan plenums with flexible connectors.

3.8 FIELD QUALITY CONTROL

- A. Arrange for inspection of all isolation and noise control equipment by the vibration isolation vendor and submit post-installation inspection report.
- B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.
- C. Guarantee: If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

END OF SECTION

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SECTION 15190 (230553) - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Ceiling tacks.
- F. Engraved plastic-laminate signs.

1.2 SUBMITTALS

- A. Custom Signage: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Product Data: Submit manufacturer's technical product data for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures and installation for each product required.

1.3 SPARE PARTS

- A. Furnish minimum of 5 percent extra stock of each mechanical identification material required for each system that uses the identification material.
- B. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock along with stenciling paints and applicators.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Advanced Graphic Engraving, LLC.
- B. Brady Corporation.
- C. Brimar Industries, Inc.

- D. Craftmark.
- E. Industrial Safety Supply Co., Inc.
- F. Kolbi Pipe Marker Co.
- G. MIFAB, Inc.
- H. Seton Identification Products, a Tricor Direct Company..

2.2 IDENTIFICATION APPLICATIONS AND REQUIREMENTS

- A. General:
 1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, selection is the installer's option, but provide single selection for each product category.
 2. Lettering: Coordinate names, abbreviations, and other designations used in mechanical identification work with the corresponding designations shown on the drawings, scheduled, and specified. If not otherwise indicated, provide numbering, lettering, and wording as recommended by the manufacturer or as required for proper identification, operation, and maintenance of mechanical systems and equipment.
 3. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (e.g., Boiler No. 3, Air Supply No. 1H, etc.).
- B. Air Terminal Units: Tags, stencils, or engraved plastic laminate signs.
- C. Automatic Controls: Tags, use the same naming convention coordinated with the building automation system.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks where located above lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.
- F. Ductwork: Adhesive-backed duct markers. Stencils are only acceptable for concealed ductwork, exterior ductwork, or in mechanical rooms.
- G. Fans: Nameplates, stencils, or engraved plastic laminate signs.\
- H. Fan Coil Units: Nameplates, stencils, or engraved plastic laminate signs.
- I. Instrumentation: Tags.
- J. Major Control Components including Variable Frequency Drives: Nameplates or engraved plastic laminate signs.
- K. Relays: Tags.
- L. Rooftop Units: Nameplates, stencils, or engraved plastic laminate signs.
- M. Small-sized Equipment: Tags.

- N. Thermostats: Nameplates.
- A. Drop Box diffusers: Tags, stencils, or engraved plastic laminate signs on bottom of the drop box diffuser with related RTU #. Drop box tag shall be large enough to be readable from floor.
- O. General Signs: Engraved plastic laminate signs.

2.3 NAMEPLATES

- A. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1. Name and mark number.
 - 2. Equipment service.
 - 3. Design capacity.
 - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- B. Size: 2-1/2 inch x 4 inch for control panels and components, 4-1/2 inch x 6 inch for equipment.
- C. Letter Color: White.
- D. Letter Height: 1/4 inch.
- E. Background Color:
 - 1. Cooling equipment: Green.
 - 2. Heating equipment: Yellow.
 - 3. Combination cooling and heating equipment: Yellow/Green.
 - 4. Energy reclamation equipment: Brown.
 - 5. Hazardous equipment: Colors and designs recommended by ASME.
 - 6. Equipment and components that do not meet any of the above criteria: Blue.
- F. Plastic: Conform to ASTM D709.

2.4 TAGS

- A. Plastic Laminate Tags: Laminated three-layer plastic, minimum 3/32 inch thick, with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.
- B. Solid Plastic Tags: Solid plastic, minimum 3/32 inch thick, with printed black letters on white color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.
- C. Metal Tags: Provide 19-gauge polished brass with stamped letters. Tag size minimum 1-1/2 inch diameter with smooth edges and 5/32 inch hole for fastener. Fill tag engraving with black enamel paint.
- A. Accident Prevention Tags: Pre-printed or partially pre-printed, of plasticized card stock with matte finish suitable for writing, minimum 3-1/4 inch x 5-5/8 inch size, with brass grommet in hole for fastener. Order with appropriate pre-printed wording (e.g., DANGER, CAUTION, DO NOT OPERATE, etc.).
- D. Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks of the size required for proper attachment of tags to valves, manufactured specifically for that purpose.

- E. Letter Height:
 - 1. System Abbreviation: Minimum 1/4 inch.
 - 2. Valve Number: Minimum 1/2 inch.

2.5 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.
- B. Style: Individual label.
- C. Nomenclature: Include air handling unit identification number, duct size, service, and arrows indicating direction of flow.
- D. Specialty Exhaust: Identify the specialty using the system terminology (e.g., Grease, Dishwasher, Dryer, Fume Hood, etc.).
- E. Color: Yellow background with black lettering or blue background with white lettering.
 - 1. Hazardous Exhaust: Use colors and designs recommended by ASME A13.1.

2.6 STENCILS

- A. Stencils: With clean cut symbols and letters of following size, complying with ASME A13.1:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
 - 7. Access Doors: 3/4 inch high letters.
 - 8. Operational Instructions: 3/4 inch high letters.
 - 9. Provide arrows indicating direction of flow.
- B. Stencil Paint: Oil based, alkyd enamel, either brushing grade or pressurized spray-can form and grade, black color, except for piping. For piping systems use colors conforming to ASME A13.1.

2.7 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color:
 - 1. HVAC Equipment: Yellow.

2.8 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Engraving stock melamine plastic laminate, engraved with manufacturer's standard letter style, black with white core letter color except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

- B. Thickness: 1/16 inch thick for units up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Nomenclature: When used to identify equipment, match terminology on schedules, including the following:
 - 1. Name and mark number.
 - 2. Equipment service.
 - 3. Design capacity.
- E. Access Panel Markers: Laminated three-layer plastic, minimum 1/16 inch thick and 1/8 inch hole for fastener, with abbreviations and numbers corresponding to concealed valve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.2 GENERAL INSTALLATION

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install products in accordance with manufacturer's instructions.
- C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. Install tags on piping 3/4 inch diameter and smaller.
- E. Install in clear view and align with axis of piping.
- F. Apply stencil painting in accordance with Division 09.
- G. Identify service, flow direction, and pressure.

3.3 DUCTWORK IDENTIFICATION

- A. Install identification on the most obviously visible portion of the duct from the point of access.

- B. Location: Install ductwork identification where ductwork is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc), and exterior non-concealed locations as follows:
 - 1. Within 5 feet of each control damper or balancing damper, excluding balancing dampers installed in duct take-offs to individual grilles, registers, or diffusers that are less than 25 feet in lengths and installed in the same space as the air device.
 - 2. Within 5 feet of each branch duct, excluding branch ducts that are less than 25 feet in length and located in the same space as the main duct.
 - 3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.
 - 4. Spaced intermittently at a maximum spacing of 50 feet along each duct run. Reduce spacing to 25 feet in congested areas when there are more than two types of duct systems or pieces of equipment.
 - 5. Within 5 feet of equipment outlets and other points of origin or termination.
 - 6. Install marker on the most obviously visible portion of the duct from point of access.

3.4 ACCESS DOOR IDENTIFICATION

- A. Provide identification on each access door, indicating purpose of access, maintenance and operating instructions, and appropriate safety and procedural information.
- B. Where access doors are concealed above a removeable ceiling system or similar concealment, tags may be used in lieu of specified identification.

3.5 CEILING TACK INSTALLATION

- A. Locate ceiling tacks to locate dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.6 EQUIPMENT IDENTIFICATION

- A. Install nameplates and engraved plastic laminate signs for identification of equipment. Provide additional signs and lettering as follows:
 - 1. To distinguish between multiple units in close proximity.
 - 2. To inform operator of operational requirements.
 - 3. To indicate safety and emergency precautions.
 - 4. To warn of hazards and improper operations.
- B. Adjust lettering size based on viewing distance from normal location of identification:
 - 1. Less than 2 feet: Minimum 1/4 inch.
 - 2. Up to 6 feet: Minimum 1/2 inch.
 - 3. Greater than 6 feet: Proportionally increase letter size based on recommendations above.
 - 4. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 5. Stencils may be used in lieu of nameplates when lettering greater than 1 inch is needed for proper identification because of distance from normal location of required identification.
- C. Where equipment to be identified is concealed above acoustical ceilings or similar removeable concealment, equipment tags may be installed in the concealed space to reduce the amount of text in exposed sign.

END OF SECTION

SECTION 15990 (230593) - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General testing, adjustment, and balancing requirements.
- B. Pre-testing, adjustment, and balancing of existing air systems.
- C. Testing, adjustment, and balancing of air systems.
- D. Testing, adjustment, and balancing of domestic water systems.
- E. Sound and vibration measurement of equipment operating conditions.
- F. This section excludes:
 - 1. Specifications for materials for patching mechanical systems.
 - 2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
 - 3. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 DEFINITIONS

- A. TAB: Testing, adjusting, and balancing.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the major or entire fluid flow of the system.

- I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.
- K. Branch: Duct or pipe serving a single terminal.

1.3 SUBMITTALS

- A. Qualifications:
 - 1. Submit qualifications of TAB agency.
 - 2. Submit qualifications of TAB supervisor.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
- C. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Preconstruction Test Report:
 - 1. Submit preconstruction test report of existing systems as indicated on the drawings. Submit report prior to start of construction on the affected systems for review and comment by the engineer. Reference Part 3 for test procedures.
 - 2. Report format shall follow Draft Report procedures specified above.
 - 3. Report shall include all information requested by the procedures for each system covered by the scope of work. Information omitted or missed during the initial or subsequent pretests shall be documented via additional site visits at no additional cost to the owner.
- F. Progress Reports.
- G. Certified TAB Reports:
 - 1. General:
 - a. Submit within two weeks after completion of testing, adjusting, and balancing.
 - b. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - c. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 2. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - 3. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:
 - a. The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
 - b. The report reflects an accurate representation of how the systems have been installed.
 - c. The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
 - d. The report is an accurate record of all final quantities measured to establish normal operating values of the systems.

4. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:
 - a. General Information and Summary
 - 1) Include project name, location, altitude, and date.
 - 2) Identify TAB agency, contractor, owner, architect, and engineer.
 - 3) Include addresses, contact names, and telephone numbers.
 - 4) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
 - 5) Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - b. Air Systems
 - c. Temperature Control Systems
 5. Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.
 6. Units of Measure: Report data in I-P (inch-pound) units only.
- H. Project Record Documents: Provide drawings that record actual locations of flow measuring stations and balancing devices.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter “Testing, Adjusting, and Balancing”, most current edition.
- C. TAB Agency Qualifications:
 1. Act as the single source of responsibility for TAB of the HVAC systems.
 2. Staff the project at all times by qualified personnel.
 3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
 4. Certified by one of the following Certification Associations:
 - a. AABC (NSTSB): Associated Air Balance Council, National Standards for Total System Balance.
 - b. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - c. TABB: Testing, Adjusting, and Balancing Bureau, SMACNA TAB Procedural Guide.
- D. TAB Supervisor and Technician Qualifications:
 1. Certified by the same organization as TAB agency.
 2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.

PART 2 - PRODUCTS AND MATERIALS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.
- B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- C. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.
- D. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- E. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.
- F. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.
- G. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- H. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Motors and bearings are lubricated.
 - 5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 6. Duct systems are clean of debris.
 - 7. Fans are rotating correctly and belts have tension.
 - 8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
 - 9. Air coil fins are cleaned and combed.
 - 10. Volume dampers are installed at locations needed for balancing the air systems.
 - 11. Access doors are closed and duct end caps are in place.
 - 12. Air outlets are installed and connected.
 - 13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.
 - 14. Domestic water systems are flushed, filled, and vented.
 - 15. Domestic water systems are tested for leaks.
 - 16. Test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves are properly installed and that their location is accessible.

17. Pumps are rotating correctly.
18. Proper strainer baskets are clean and in place.
19. Service and balance valves are open.
20. Expansion tanks are not air bound and have appropriate charge.
21. Air vents are operating freely.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.

B. Furnish all instruments required for testing, adjusting, and balancing operations.

1. Verify all instruments have been calibrated.
2. Furnish instruments as recommended by the manufacturer for the TAB application.
3. Furnish instruments that are best suited to the function being measured.
4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.

D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.

E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

F. Determine best locations in main and branch ductwork for most accurate duct traverses.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.

B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.

3.5 RECORDING AND ADJUSTING

A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.

B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:

1. Dry bulb temperature.
 2. Relative humidity.
 3. Cloud cover.
 4. Wind speed.
 5. Time.
- C. Field Logs: Maintain written logs including:
1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- D. Ensure recorded data represents actual measured or observed conditions.
- E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.
- J. Seal ducts and piping and test and repair leaks.
- K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- M. Check and adjust systems approximately six months after final acceptance and submit report.
- N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.
- O. Take all readings at eye level of the indicated value to prevent parallax.
- P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- Q. Take measurements in the system where best suited for the task.
- R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.6 PRE-TESTING, ADJUSTMENT, AND BALANCING OF EXISTING AIR SYSTEMS

- A. Perform preconstruction inspection and testing of existing systems as noted on the plans. Submit test report to engineer for approval. Construction on or demolition of the pre-tested systems shall not proceed until the engineer has reviewed and approved the preconstruction test report.
- B. TAB Contractor:
 - 1. Measure and record the operating speed, airflow, and total and external static pressure of each fan system. Provide individual pressure drop readings across all coils, filter banks, dampers and other internal fan system components
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the condition of filters.
 - 4. Check the condition of coils.
 - 5. Check the operation of the drain pan and condensate-drain trap.
 - 6. Check bearings and other lubricated parts for proper lubrication.
 - 7. For variable air volume systems: Open automatic air dampers to full design position to simulate a design day. Measure and record the operating speed and airflow of each fan system for full load conditions.
 - 8. Report on the results of the measurements taken and any deficiencies.
- C. Mechanical Contractor:
 - 1. Check the refrigerant charge.
 - 2. Report on the operating condition of the equipment and any deficiencies.

3.7 AIR SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

- A. Check filters for cleanliness.
- B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- C. Verify volume dampers are installed at locations needed for balancing the air systems.
- D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- E. Determine best locations in main and branch ductwork for most accurate duct traverses.
- F. Place outlet dampers in the full open position.
- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- H. Lubricate all motors and bearings.
- I. Check fan belt tension.
- J. Check fan rotation.

- K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.
- L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- M. Measure air quantities at air inlets and outlets.
- N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.
- P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- U. Where modulating dampers are provided, take measurements and balance at design conditions. Balance variable volume systems at design air flow rate and at minimum air flow rate.
- V. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship to maintain building pressure setpoint.
- W. Multi-Zone units with Mixing Dampers: Check for motorized damper leakage. Adjust air quantities with mixing dampers set first at design cooling, then at design heating.
- X. For variable air volume boxes, set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- Y. Procedure for establishing minimum and absolute minimum outdoor air damper position on air handling units:
 1. Open the minimum outdoor air damper and return air damper fully. Close the economizer air damper.
 2. Operate supply fan at design speed and measure the outdoor airflow.
 3. If the outdoor airflow is above the scheduled minimum ventilation airflow, adjust the damper linkage on the minimum outdoor air damper so that outdoor airflow equals the scheduled minimum ventilation airflow with damper fully stroked.
 4. If outdoor airflow is below the scheduled minimum ventilation airflow, adjust the damper linkage on the return air damper so that outdoor airflow equals the schedule minimum ventilation airflow with the damper fully stroked.
 5. Convey the measured setpoint and/or damper position to the BAS installer and note on air balance report.

6. Repeat this procedure to determine damper position for absolute minimum ventilation.

3.8 DOMESTIC WATER SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

A. Before balancing the system perform these steps:

1. Open valves to full open position.
2. Examine plumbing system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices and balancing valves and fittings are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
3. Remove and clean all strainers.
4. Check pump rotation.
5. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
6. Lubricate all motors and bearings.

END OF SECTION

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SECTION 15250 (230700) - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. External Ductwork Insulation.

1.2 RELATED REQUIREMENTS

- A. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, pipe saddles, and high-density insulation inserts.
- B. Division 23 Section "Metal Ducts" for duct liner insulation.

1.3 DEFINITIONS

- A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.
- B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.
- C. Cold Duct: Ductwork that carries airflow with a minimum operating temperature less than [65 degrees F] temperature.
- D. Hot Duct: Ductwork that carries airflow with a minimum operating temperature greater than [75 degrees F] temperature.
- E. Exposed: Insulation that is visible from the occupied space.
- F. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.
- G. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.
- H. Unconditioned Spaces: An enclosed space within a building that is not provided with mechanical heating or cooling.

1.4 SUBMITTALS

- A. Product Data: Submit technical product data, thermal characteristics, and materials for each type of mechanical insulation.

- B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
- D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
 - 1. Exception: Exterior mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
 - 3. Exception: Polyisocyanurate insulation that is not installed in a return air plenum may have a flame spread index of 25 and smoke developed index of 450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 PIPING INSULATION MATERIALS

- A. Mineral Fiber (rock, slag, or glass):
 - 1. Manufacturers:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.

- d. Owens Corning.
 - 2. Insulation: ASTM C547, Type I or II, rigid mineral fiber, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.24 at 75 degrees F.
 - b. Minimum Service Temperature: 0 degrees F
 - c. Maximum Service Temperature: 850 degrees F for Type I, 1200 degrees F for Type II.
 - d. Density: Between 3 to 6 pounds per cubic foot for Type I, between 6 to 8 pounds per cubic foot for Type II.
 - 3. Factory Applied Jacket: ASTM C1136, Type I.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms and self-sealing lap.
 - b. Poly ASJ: Paper/Foil/Scrim with polymer coating, water vapor permeance of 0.01 perms and self-sealing lap.
 - c. Color: White.
- B. Cellular Glass:
- 1. Manufacturers:
 - a. Owens Corning.
 - 2. Insulation: ASTM C552, Type II, Grade 6, rigid closed glass cells pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.34 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 450 degrees F.
 - c. Maximum Service Temperature: 800 degrees F.
 - d. Density: Minimum 6.12 pounds per cubic feet.
- C. Polyisocyanurate:
- 1. Manufacturers:
 - a. Dyplast Products.
 - b. Johns Manville.
 - c. Approved equal.
 - 2. Insulation: ASTM C591, Grade 2, Type IV for ASTM E84 25/50 compliance, Type I for ASTM E84 25/450 compliance; rigid molded, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.2 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 297 degrees F
 - c. Maximum Service Temperature: 300 degrees F.
 - d. Density: Maximum 6 pounds per cubic feet.
- D. Flexible Elastomeric:
- 1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - 2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 297 degrees F
 - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
 - 3. Factory Applied Jacket:
 - a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Piping Jacket Schedule in Part 3 of this specification for application of this jacket.
- E. Field-Applied Jacket:
- 1. Canvas: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

2. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
 - a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
 - b. Manufacturers:
 - 1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
 - 2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
 - 3) Or approved equal.
3. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:

Outer Insulation Diameter (in)	Minimum Aluminum Jacket Thickness, (in)		
	Non-Rigid Insulation	Rigid Insulation	Finish
≤ 8	0.016	0.016	Stucco
< 12	0.020	0.016	Stucco
≤ 24	0.024	0.016	Stucco

Note 1: Use corrugated finish for non-rigid insulation. Use stucco finish for rigid insulation.

- a. Banding:
 - 1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
 - 2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.
 4. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, Polyguard Zero-Perm, or approved equal.
 5. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulated duct and piping applications. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.
- F. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- G. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
 2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
 3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
 4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02
Ducts (40 F to ambient)	1.0	0.03

Notes:

1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.

5. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.
- H. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- I. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- J. High Density Insulation Billets:
1. Flexible elastomeric: ASTM C534, Type 1.
 2. Polystyrene: ASTM C578, Type XIII.
 3. Phenolic: ASTM C1126, Type III, Grade 1.

2.2 EXTERNAL DUCTWORK INSULATION MATERIALS

- A. Flexible Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Insulation: ASTM C553, Type I or II, flexible mineral fiber blanket.
 - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 20 degrees F
 - c. Maximum Service Temperature: 450 degrees.
 - d. Density:
 - 1) 1.5 pounds per cubic foot.
 3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
 - a. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms and 2 inch stapling tab.
 - b. Polypropylene Scrim Kraft (PSK): Kraft paper with glass fiber yarn and bonded to metalized polypropylene, water vapor permeance of 0.02 perms and 2 inch stapling tab.
 - c. Color: Black.
- B. Rigid Mineral Fiber (rock, slag, or glass):
1. Manufacturers:
 - a. Johns Manville.
 - b. Knauf Insulation.
 - c. Owens Corning.
 2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
 - a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
 - b. Minimum Service Temperature: 0 degrees F
 - c. Maximum Service Temperature: 450 degrees.
 - d. Density:
 - 1) 3.0 pounds per cubic foot.
 3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
 - b. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms.
 - c. Polypropylene Scrim Polyester (PSP): Polyester paper with glass fiber yarn and bonded to polypropylene, water vapor permeance of 0.02 perms.
 - d. Color: White.
- C. Cellular Glass:

1. Manufacturers:
 - a. Owens Corning.
 2. Insulation: ASTM C552, Type I, Grade 6, rigid closed glass cells, block form.
 - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 450 degrees F.
 - c. Maximum Service Temperature: 800 degrees F.
 - d. Density: Minimum 6 pounds per cubic feet.
- D. Polyisocyanurate:
1. Manufacturers:
 - a. Dyplast Products.
 - b. Johns Manville.
 - c. Approved equal.
 2. Insulation: ASTM C591, Grade 2, Type IV for ASTM E84 25/50 compliance, Type I for ASTM E84 25/450 compliance; rigid board.
 - a. K-value: ASTM C518 or C177, maximum 0.2 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 297 degrees F
 - c. Maximum Service Temperature: 300 degrees F.
 - d. Density: Maximum 6 pounds per cubic feet.
- E. Flexible Elastomeric:
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 2. Insulation: ASTM C534, Grade 1, flexible elastomeric cellular rubber insulation, sheet form.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 40 degrees F
 - c. Maximum Service Temperature: 180 degrees F.
 3. Factory Applied Jacket:
 - a. Flexible Metal Cladding: Metallic factory-laminated cladding, 17.5 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.00 perms. Provide ArmaTuff or equal. Reference Duct Jacket Schedule in Part 3 of this specification for application of this jacket.
- F. Field-Applied Jacket:
1. Canvas: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 2. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
 - a. Thickness: 0.032 inch sheet.
 - b. Finish: Smooth or Stucco. Reference Part 3 for jacket applications.
 - c. Joining: Longitudinal slip joints and 2 inch laps.
 - d. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
 - e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
 3. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, Polyguard Zero-Perm, or approved equal.
 4. Rubberized Asphalt Vapor Barrier Cladding: UV-resistant aluminum outer layer, multi-ply cross-laminated polyethylene film, and rubberized asphalt formulated for use on faced insulation. Provide Polyguard Products, Inc. Alumaguard 60 mils thick cladding, Alumaguard Low Temp (LT) 35 mils thick cladding, or approved equal.

- G. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, pins with insulation retaining washers, anchors, corner angles and other appurtenances as recommended by insulation manufacturer for applications indicated.
- H. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coatings, sealers, mastics, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.
 - 1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
 - 2. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
 - 3. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Fosters 30-80, Childers CP-38, Design Polymerics 3040, or equal.
 - 4. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
 - 5. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 PROTECTION AND REPLACEMENT

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.
- B. Repair existing mechanical insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.
- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.3 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

3.4 PIPING SYSTEM INSULATION INSTALLATION

- A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.

- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Exposed Piping: Locate insulation and cover seams in least visible locations.
- E. Cold Pipe Insulation:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Provide vapor barrier jacket according to the Piping Jacket Schedule.
 - 3. Provide high density insulation material under supports or pre-insulated supports.
 - 4. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers & Supports for HVAC Piping & Equipment" for pre-insulated supports and insulation shields.
 - 5. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 - 6. Secure all-service jacket with self-sealing longitudinal laps.
 - 7. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- F. Insulation of Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Insulate fittings, joints, and valves with molded insulation of like material, vapor barrier coating, and thickness as adjacent pipe. Provide pre-formed insulation pieces, segmented insulation, or sectional pipe insulation for the application. Provide the same insulation jacket as adjoining pipe.
 - 2. Sectional pipe insulation: Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Hold sectional cuts in place with tie wire or bands. Wire and bands shall be compatible with insulation and jacket.
 - 3. Segmented pipe insulation: Cover segmented insulated surfaces with a layer of finishing cement and finish with a coating or mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the coating or mastic to a smooth and well-shaped contour.
 - 4. Butt each insulation piece tightly against adjoining piece of insulation. Bond pieces together according to Cold Pipe or Hot Pipe installation instructions.
 - 5. When removeable covers are made from sectional block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, around the insulated device with tie wire. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 6. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. PVC fitting covers with end caps are also acceptable. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 7. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated. Maintain vapor barrier through the penetration.
- H. Exterior Piping and Piping Exposed to Weather:
 - 1. General: Provide piping jacket around insulation as scheduled in the Piping Jacket Schedule. Jacket material shall be approved by the jacket manufacturer for use with the specific insulation material that it covers. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.

2. Paintable Coating: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
3. Polymeric Coating: Provide insulation shields so that the piping supports do not puncture, cut or break the jacket.
4. Rigid aluminum shell: Space attachment bands 12 inches on center and directly centered over end joints.
5. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
6. Rubberized Asphalt Vapor Barrier Cladding: Install cladding for use in ambient temperatures as low as minus 10 degrees F.

3.5 PIPING SYSTEM INSULATION SCHEDULE

- A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.
- B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.
- C. Exterior Piping: Insulate all exterior HVAC piping with one of the following:
 1. Cellular glass.
 2. Flexible elastomeric, use high temperature formula for systems with operating temperatures above 220 F. (not acceptable for steam, steam condensate or hot water piping systems with temperatures above 300 F).
- D. Variable Refrigerant Flow (VRF) Piping:
 1. Service:
 - a. All refrigerant piping in cooling only, heat pump, or heat recovery VRF systems.
 2. Acceptable Insulation:
 - a. Flexible elastomeric.
- E. Warm Temperature Piping (105 degrees to 140 degrees F (40 to 94 degrees C)):
 1. Service:
 - a. Refrigerant hot gas lines between the compressor and condensing unit.
 - b. Refrigerant liquid lines between the condensing unit and expansion valve.
 2. Insulate each piping system specified above with one of the following types of insulation.
 - a. Mineral fiber.
 - b. Cellular glass.
 - c. Polyisocyanurate.
 - d. Flexible elastomeric.

3.6 PIPE INSULATION THICKNESS SCHEDULE

- A. California Building Efficiency Standards (Title 24 – Part 6) Requirements, Pipe Insulation

	Minimum Pipe Insulation Thickness						
	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
Fluid Operating Temp. Range (°F) And Usage	Conductivity, Btu·in./(hr·ft ² ·°F)	Mean Rating Temp., °F.	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness, in.				

>350°F	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251°F–350°F	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201°F–250°F	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.22–0.28	100	1.0	1.5	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
<40°F	0.20–0.26	50	1.0	1.5	1.5	1.5	1.5

Notes:

- a. For insulation outside the stated conductivity range for the applicable fluid temperature range, the minimum thickness (T) shall be determined as follows: $T = r[(1 + t/r)^{(K/k)} - 1]$ where
 - 1) T = minimum insulation thickness (in.),
 - 2) r = actual outside radius of pipe (in.),
 - 3) t = insulation thickness listed in this table for applicable fluid temperature and pipe size,
 - 4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu-in./hr-ft²-°F), determined in accordance with ASTM C335; and
 - 5) k = the lower value of the conductivity range listed in this table for the applicable fluid temperature.
- b. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.
- c. For piping that shall be installed below grade, reference Division 23 section “Underground Hydronic and Steam Piping.”
- d. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

3.7 PIPING JACKET SCHEDULE

- A. Exposed piping:
 1. All-service jacket.
 2. Semi-rigid PVC.
- B. Piping within return air plenums:
 1. All-service jacket.
- C. Exterior piping and piping exposed to weather:
 1. Paintable coating (flexible elastomeric insulation only.)
 2. Polymeric Coating (flexible elastomeric insulation only).
 3. Semi-rigid PVC for outdoor application (flexible elastomeric insulation on refrigerant piping only).
 4. Rigid aluminum shell.
 5. Multilayer laminate vapor barrier cladding.
 6. Rubberized asphalt vapor barrier cladding.

3.8 DUCTWORK INSULATION SYSTEM INSTALLATION

- A. Maintain continuous thermal and vapor-barrier integrity throughout entire installation and protect it from puncture and other damage.

- B. Install insulation on duct systems subsequent to painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces.
- D. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Install insulation without sag on underside of duct. Where rectangular ducts are 24 inches in width or greater, secure external insulation to the bottom of the duct with mechanical fasteners, spaced on 18 inches on center (maximum). Fasteners shall include 2-inch square self-sticking galvanized carbon-steel base plates with minimum 0.106-inch diameter zinc-coated, low carbon steel, fully annealed shank spindle, length to suit depth of insulation. Secure insulation to spindles with self-locking washers incorporating a spring steel insert to ensure permanent cap retention. Lift duct off trapeze hangers and insert spacers to avoid insulation compression.
- F. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.
- H. Lined Ductwork: At interface of lined and wrapped ductwork, overlap lined ductwork by 2 feet (minimum) with wrapped insulation.
- I. Cold Ducts:
 1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
 2. Provide vapor barrier jacket according to the Ductwork Jacket Schedule.
 3. Seal joints with vapor barrier mastic.
 4. Continue insulation, including vapor barrier, through walls, sleeves, hangers, and other duct penetrations.
 5. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 6. Where cold ducts are installed in mechanical rooms or non-conditioned spaces (excludes return air plenums), prevent condensation from forming on the duct supports by providing one or more of the following:
 - a. Install thermal break such as rigid board insulation between the support and duct.
 - b. Wrap support that is in contact with the duct with external duct wrap insulation to prevent condensation. Wrap shall extend a minimum of 12 inches from point of contact of the support with the duct. Tape joints to provide a thermal and vapor barrier. Coat all taped joints, punctures and seams with 4 inch wide coating of vapor barrier mastic.
 - c. If a support device similar to Unistrut is used, foam fill or stuff tube.
- J. Hot Ducts:
 1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
 2. Provide jackets with or without vapor barrier according to the Ductwork Jacket Schedule.
 3. Secure joints with staples, tape, or wires.
 4. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.9 DUCTWORK SYSTEM INSULATION SCHEDULE

- A. Omit insulation on the following:
 1. Fibrous glass ductwork (ductboard).
 2. Lined ductwork.
 3. Ductwork with sound absorbing linings.

- B. Prohibited insulation:
 - 1. Polyisocyanurate installed within a return air plenum.

- C. Outdoor Air:
 - 1. Service:
 - a. Interior untreated outdoor air intake ducts.
 - 2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Cellular glass.
 - d. Polyisocyanurate.
 - e. Flexible elastomeric.

- D. Supply Air:
 - 1. Service:
 - a. Supply ducts from air handling equipment.
 - b. Insulate neck and bells of supply diffusers.
 - 2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Cellular glass.
 - d. Polyisocyanurate.
 - e. Flexible elastomeric.

- E. Return Air:
 - 1. Service:
 - a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
 - 2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Cellular glass.
 - d. Polyisocyanurate.
 - e. Flexible elastomeric.

- F. Exhaust Air.
 - 1. Service:
 - a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
 - 2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Cellular glass.
 - d. Polyisocyanurate.
 - e. Flexible elastomeric.

3.10 DUCT SYSTEM INSULATION THICKNESS SCHEDULE

- A. Flexible Mineral Fiber:
 - 1. Interior Ductwork:
 - a. 0.75 pounds per cubic foot density:
 - 1) 1-1/2 inch thick, minimum R-4.2.
 - b. 1.5 pounds per cubic foot density:
 - 1) 1-1/2 inch thick, minimum R-4.2.
 - 2. Meet R-value installed at maximum 25% compression, application limited to concealed locations.

B. Rigid Mineral Fiber:

1. Interior Ductwork:
 - a. 1.5 pounds per cubic foot density:
 - 1) 1 inch thick, minimum R-4.2.
 - b. 3 pounds per cubic foot density:
 - 1) 1 inch thick, minimum R-4.2.
 - c. 6 pounds per cubic foot density:
 - 1) 1 inch thick, minimum R-4.2.
2. Ductwork installed in machine, fan, and mechanical equipment rooms:
 - a. 2 inch thick, minimum R-8.0.
3. Exterior Ductwork or Ductwork Exposed to Weather, or Ductwork:
 - a. 2 inch thick, minimum R-8.0.
4. Ductwork in an Unconditioned Space:
 - a. 2 inch thick, minimum R-8.0.

C. Cellular Glass:

1. Interior Ductwork:
 - a. 1-1/2 inch thick, minimum R-5.0.
2. Exterior Ductwork or Ductwork Exposed to Weather, or Ductwork:
 - a. 2-1/2 inch thick, minimum R-8.0.
3. Ductwork in an Unconditioned Space:
 - a. 2 inch thick, minimum R-8.0.

D. Polyisocyanurate:

1. Interior Ductwork:
 - a. 1 inch thick, minimum R-6.0.
2. Exterior Ductwork or Ductwork Exposed to Weather:
 - a. 1-1/2 inch thick, minimum R-8.0.
3. Ductwork in an Unconditioned Space:
 - a. 2 inch thick, minimum R-8.0.

E. Flexible Elastomeric:

1. Interior Ductwork:
 - a. 1 inch thick, minimum R-4.2.
2. Exterior Ductwork or Ductwork Exposed to Weather:
 - a. 2 inch thick, minimum R-8.0.
3. Ductwork in an Unconditioned Space:
 - a. 2 inch thick, minimum R-8.0.

3.11 DUCTWORK JACKET SCHEDULE

A. Omit jacket on internally lined ductwork.

B. Exposed ductwork within mechanical rooms (below 10 feet):

1. Foil Scrim Kraft (FSK).
2. Polypropylene Scrim Kraft (PSK).
3. All-Service Jacket (ASJ).
4. Polypropylene Scrim Polyester (PSP).
5. Flexible Metal Cladding (flexible elastomeric only).
6. Aluminum with smooth finish.

C. Exposed ductwork within mechanical rooms (above 10 feet):

1. Foil Scrim Kraft (FSK).

2. Polypropylene Scrim Kraft (PSK).
3. All-Service Jacket (ASJ).
4. Polypropylene Scrim Polyester (PSP).
5. Flexible Metal Cladding (flexible elastomeric only).

D. Exposed ductwork:

1. Foil Scrim Kraft (FSK).
2. Polypropylene Scrim Kraft (PSK).
3. All-Service Jacket (ASJ).
4. Polypropylene Scrim Polyester (PSP).
5. Flexible Metal Cladding (flexible elastomeric only).
6. Aluminum with smooth finish.

E. Ductwork within return air plenums:

1. Foil Scrim Kraft (FSK).
2. Polypropylene Scrim Kraft (PSK).
3. All-Service Jacket (ASJ).
4. Polypropylene Scrim Polyester (PSP).
5. Flexible Metal Cladding (flexible elastomeric only).

F. Ductwork in an unconditioned space:

1. Foil Scrim Kraft (FSK).
2. Polypropylene Scrim Kraft (PSK).
3. All-Service Jacket (ASJ).
4. Polypropylene Scrim Polyester (PSP).
5. Flexible Metal Cladding (flexible elastomeric only).

G. Exterior ductwork and ductwork exposed to weather:

1. Flexible Metal Cladding (flexible elastomeric only).
2. Aluminum with stucco finish.
3. Multilayer Laminate Vapor Barrier Cladding.
4. Rubberized Asphalt Vapor Barrier Cladding.

END OF SECTION

SECTION 15991 (230800) - COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Commissioning process requirements for HVAC systems, assemblies, and equipment.

1.2 SUMMARY

- B. Retain the services of a third-party registered design professional or approved agency that is regularly engaged in conducting commissioning to develop a commissioning plan, supporting documentation, and reports.
- A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned shall be responsible for the commissioning activities relating to that system or equipment item.
- B. The Commissioning Authority (CxA) shall direct and coordinate all commissioning activities and provide Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- C. The entire HVAC system and its appurtenances shall be commissioned, including controls, ductwork, piping, noise and vibration control devices, specialty systems (e.g., smoke control systems), and other systems identified elsewhere in the Contract Documents.
- D. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.3 RELATED REQUIREMENTS

- A. Division 01 Commissioning requirements that apply to all types of work.

1.4 REFERENCE STANDARDS

- A. ASHRAE Guideline 0 – The Commissioning Process, most current edition.
- B. - The HVAC Commissioning Process; most current edition.

1.5 DEFINITIONS

- C. Refer to Division 01 “General Commissioning Requirements” for additional abbreviations and definitions.
- A. BAS: Building Automation System.
- B. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

- C. Commissioning Authority (CxA): An entity identified by the Owner who coordinates the commissioning team to implement the Commissioning Process.
- D. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
- E. Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the OPR. Commissioning is intended to achieve the following objectives:
 - 1. Verify that applicable systems and equipment are designed and installed according to the manufacturer's recommendations and to industry accepted minimum standards.
 - 2. Verify that applicable systems and equipment receive adequate operational checkout by installing contractors.
 - 3. Verify and document proper performance of equipment and systems.
 - 4. Verify that O&M documentation provided to the Owner is complete.
 - 5. Verify that the Owner's operating personnel are adequately trained.
- F. Commissioning Report: A report that includes the following:
 - 1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
 - 2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
 - 3. Itemization of resolved deficiencies found during preliminary commissioning.
 - 4. List of deferred tests that cannot be performed at the time of final commissioning report preparation because of climatic conditions.
- G. Functional Performance Test (FPT): A test that verifies the equipment or item being tested performs in the manner intended.
- H. Owner's Project Requirements (OPR). A document that details the functional requirements of a project and the expectations of how it will be used and operated, including the following:
 - 1. Project goals.
 - 2. Energy efficiency goals.
 - 3. Ventilation requirements.
 - 4. Project documentation requirements
 - 5. Facility functions.
 - 6. Hours of operation and any need for after-hours operation.
 - 7. Equipment and system expectations.
 - 8. Building envelope performance expectations.
 - 9. Measurable performance criteria.
 - 10. Cost considerations.
 - 11. Benchmarks.
 - 12. Success criteria
 - 13. Supporting information.
- I. Operations and Maintenance Manual (O&M): A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner during the occupancy and operation of the building.
- J. Pre-Functional Checklist (PFC): A checklist that verifies all components and accessories related to a system that will be subjected to an FPT are present and functional.

- K. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- L. TAB: Testing, Adjusting, and Balancing.

1.6 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to the HVAC system documentation made during installation, and startup; revise and resubmit when substantial changes are made.
- D. Submit a commissioning plan that includes the following:
 - 1. General project information and commissioning goals.
 - 2. Commissioning team information.
 - 3. Narrative description of commissioning process activities, schedules, responsibilities, and personnel required during commissioning.
 - 4. List of equipment and systems to be tested with description of tests to be performed. Include an explanation of the original design intent.
 - 5. List of functions to be tested, including calibration and economizer controls.
 - 6. List of conditions under which the tests shall be performed.
 - 7. List of measurable criteria for performance.
- B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
 - 1. System name.
 - 2. List of devices.
 - 3. Step-by-step procedures for testing each controller after installation, including:
 - a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c. Process of performing operational checks of each controlled component.
 - d. Plan and process for calibrating valve and damper actuators and all sensors.
 - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - 4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 - 5. Description of the instrumentation being used for testing.
 - 6. Indicate the tests required on each system that should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Submit startup reports pre-functional tests, and trend logs for review by the Commissioning Authority.
- E. Submit a copy of the preliminary commissioning report. Preliminary commissioning report shall include the following:
 - 1. Results of preliminary functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
 - 2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
 - 3. Completed Commissioning Compliance Checklist.

4. Itemization of deficiencies found during testing that have not been corrected at the time of preliminary commissioning report preparation.
 5. List of deferred tests that cannot be performed at the time of preliminary commissioning report preparation because of climatic conditions.
 6. List of climatic conditions required for the performance of the deferred tests.
- F. Submit a final commissioning report that includes the following:
1. Results of final functional performance tests. Organize equipment and components specified by other Divisions in separate sections for independent review.
 2. List of functional performance testing procedures used during commissioning, including measurable criteria for test acceptance.
 3. Itemization of resolved deficiencies found during preliminary commissioning.
 4. Submit report to the Engineer and Owner within 90 days of the date of receipt of the certificate of occupancy.
- D. Project Record Documents:
1. Submit as-built drawings indicating changes that occurred during the construction phase.
 2. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 3. Show actual locations of all sensors on project record drawings.
- G. O&M Manual: The O&M manual shall expand upon the more traditional operating and maintenance documentation to include information gathered during the commissioning process. Include the following for each system:
1. Manufacturer information.
 2. Equipment specifications and recommendations.
 3. Programming procedures and data points.
 4. Narratives.
 5. Other means of illustrating to the Owner how the building, equipment, and systems are intended to be installed, maintained, and operated.
 6. Label that includes required regular maintenance actions for equipment and systems.
 - a. Include in the label the title or publication number for the O&M manual for the model and type of product.
 7. Site information, including facility description, history, and current requirements.
 8. Site contact information.
 9. Description of major systems.
 10. As-built control schematics for each commissioned system.
 11. As-built control sequences for each commissioned system, including final setpoints and list of all control points.
 12. Final parameters of all peripheral equipment (e.g., final parameters resident in a VFD.)
 13. Recommended operating procedures for each piece of primary equipment
 14. Instructions for integrated building systems.
 15. Instructions for basic troubleshooting.
 16. Recommended schedule of maintenance requirements and frequency, troubleshooting guidelines, and emergency procedures.
 17. Site equipment inventory and maintenance notes.
 18. Site events log.
 19. Copy of all special inspection verifications required by the enforcing agency or standards.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing. Unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. If not otherwise specified, provide test equipment certified and calibrated within the past year of use. Meet the following minimum accuracy requirements:
 - 1. Temperature sensors and thermometers: Accuracy of plus/minus 0.5 degrees F and resolution of plus/minus 0.1 degrees F.
 - 2. Pressure sensors: Accuracy of plus/minus 2.0 percent of value within the range of values being measured (not full range of sensor).
- C. Equipment-Specific Tools: Where special testing equipment, tools, and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work. Such equipment, tools, and instruments shall become the property of Owner.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

- A. The following narrative provides a brief overview of the typical commissioning tasks performed during the design, construction, acceptance, and post-occupancy phases and the general order in which they occur. Coordinate with the CxA to comply with the commissioning requirements of the project.
 - 1. Owner furnishes documentation to support the OPR and BOD to the design team and CxA.
 - 2. The CxA holds a design review kickoff meeting.
 - 3. The design team prepares construction documents to meet the OPR and BOD.
 - 4. The CxA develops the commissioning plan.
 - 5. The CxA conducts a construction document checklist review.
 - 6. Plans are permitted and construction-related submittals for all commissioned equipment are provided to the CxA during the normal submittal process.
 - 7. The CxA develops specific equipment PFCs and furnishes them to the contractor.
 - 8. The CxA conducts a kick-off meeting early during construction and presents the commissioning process for the project.
 - 9. The Contractor coordinates project construction and prepares the project for inspecting, acceptance testing, and PFCs.
 - 10. The Contractor coordinates with the CxA to execute and document the PFCs. The CxA reports on the PFC process including an issues report.
 - 11. PFCs are completed before start-up, testing and balancing, and functional testing.
 - 12. The Contractor and responsible subcontractors shall document equipment start-up and initial checkout with assistance from manufacturer's technicians. The CxA may request copies of the manufacturer's or contractor's field start-up reports.
 - 13. The CxA develops specific FPT plans for review by the Engineer, Contract Administrator and responsible subcontractors.
 - 14. The Contractor coordinates TAB for the project.
 - 15. Testing, adjusting and balancing of completed HVAC systems is completed and verified by the CxA.

16. The Contractor and responsible subcontractors complete the installation and checkout of all building control systems.
17. The CxA coordinates and executes the FPTs with the assistance of responsible subcontractors. The CxA reports on the testing process including all observed deficiencies.
18. The CxA develops a preliminary commissioning report.
19. Testing of other commissioned systems not requiring formal functional testing is completed.
20. The CxA reviews close-out documentation and schedules deferred testing.
21. The Contractor and CxA coordinate to compile the O&M manual.
22. The CxA verifies training as required by the Contract Documents is completed.
23. The CxA develops a final commissioning report.

1.2 DESIGN REVIEW KICKOFF MEETING

- A. Hold the meeting during the schematic design phase of the project.
- B. The CxA shall coordinate the following parties to be included in the meeting:
 1. Owner or owner's representative.
 2. Project manager.
 3. Design team.
 4. Design reviewer.
- C. Review the following during the meeting:
 1. OPR.
 2. BOD.
 3. Drawing set.
 4. Specifications.
 5. Project scope.
 6. Design elements and assumptions.
 7. HVAC system selection.
 8. Recommended energy efficiency measures.

3.2 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for use by the Commissioning Authority. Develop the following schedules and update the schedule as appropriate during the course of construction:
 1. Leakage testing of duct systems.
 2. Pressure testing of piping systems.
 3. Flushing and cleaning piping systems.
 4. Equipment startup.
 5. Testing, adjusting, and balancing systems.
- D. Notify the Commissioning Authority when scheduled tests shall occur. When commissioning activities not yet performed or not yet scheduled will delay construction, notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.
 - F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
 - G. Provide temperature and pressure taps in accordance with the contract documents.
 1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.
- 3.3 INSPECTING AND TESTING - GENERAL
- A. Refer to the latest adopted edition of the applicable energy code for more information.
 - B. Coordinate appropriate acceptance testing technicians to perform required acceptance tests and complete documentation for acceptance testing.
- 3.4 PREFUNCTIONAL CHECKOUT
- A. Submit startup plans, startup reports, and PFCs for each item of equipment or other assembly to be commissioned.
 - B. PFCs shall demonstrate the commissioned equipment is properly installed and ready for startup and initial operation.
 - C. Perform the PFCs directed by the CxA for each item of equipment or other assembly to be commissioned.
 - D. Document items from the PFCs and startup that were not completed successfully.
 - E. Complete and submit all PFC forms and provide notice that the equipment is ready for testing, adjusting, and balancing.
 - F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
- 3.5 TESTING AND BALANCING COORDINATION
- A. Coordinate commissioning schedule with TAB schedule.
 - B. Notify the CxA at least 7 days in advance of testing and balancing work. Provide access for the CxA to witness test TAB work.
 - C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
 - D. All required Prefunctional Checklists, calibrations, startup, and component Functional Tests of the system shall be completed and approved by the CxA prior to starting TAB.
 - E. Coordinate with the BAS and TAB Contractor to make available technicians, instrumentation, and tools to assist the CxA in verification of data points associated with TAB of HVAC systems.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. The CxA shall furnish FPT procedures to the subcontractors and equipment manufacturers for review for feasibility, safety, equipment, and warranty protection.
- B. Perform the FPTs directed by the CxA for each item of equipment or other assembly to be commissioned, including equipment, controls, and economizers. FPTs shall demonstrate the following:
 - 1. The operation, function, and maintenance serviceability for each commissioned equipment, component, and system is confirmed according to the approved plans and specifications.
 - 2. The sequence of operations, including modes, backup modes (if applicable), alarms, and mode of operation upon a loss of power and restoration of power for each control device, equipment, component, and system. Reference section Control System Functional Testing below for more information.
 - 3. Control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with the approved plans and specifications.
 - 4. Air economizers operated in accordance with manufacturer's specifications and specified sequence of operation.
 - 5. Terminal units: For multiples of like equipment (VAV terminal units, unit heaters, etc.), commission a minimum of 50 percent of total number of units.
- C. Coordinate with the responsible sub-contractors to provide trained technicians to perform commissioning tests and/or coordinate with equipment manufacturers to make available authorized technicians for the same purpose.
- D. Test equipment under design conditions when possible. Impose simulated design conditions using an artificial load when it is not practical to test under design conditions. Provide additional equipment to impose simulated loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
 - 1. The CxA may direct that set points be altered when simulating conditions is not practical.
 - 2. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- E. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- F. If the Commissioning Plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.7 DEFERRED AND SEASONAL TESTING

- A. If any PFC or FPT cannot be completed due to an unforeseen condition not within control of the Contract Administrator, defer execution of the PFC or FPT based on the recommendation of the CxA and approval of the Owner. Complete the affected testing as soon as practical.
- B. During the warranty period, complete tests purposely delayed until weather conditions are closer to the system's design conditions. The CxA shall coordinate this activity. Any final adjustments to the O&M manuals and/or as-built drawings due to the testing shall be made by the CA.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. See Division 01 and Section “General Mechanical Requirements for HVAC” for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.9 DEMONSTRATION AND TRAINING

- A. See Division 01 for additional requirements.
- B. Complete all related commissioning requirements prior to final inspections.
- C. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- D. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- E. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
- F. Provide the services of manufacturer representatives to assist instructors where necessary.
- G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
- H. Document systems operations training in the commissioning report.

END OF SECTION

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SECTION 15900 (23 09 00) - BUILDING AUTOMATION SYSTEM

09-03-2021	Original Issue
10-11-2021	Revised to reduce manufacturer list to Walmart approved providers only, running on Walmart network, without option for stand-alone, non-network attached systems. Updated sequence of operations based upon common control sequences utilized in Walmart buildings.
10-27-2021	Revised to expand approved providers and reduced specification language to limit information approved providers need to execute the work.
12-01-2021	Added contact for intelli-building systems and made adjustments to the requirements to align with Walmart Global Tech requirements.
1-14-2022	Add note regarding placement of primary and secondary controllers (within secured rooms located in office areas, coordinated during shop drawing review).

PART 1 - GENERAL

1.01 RELATED SECTIONS:

- A. Drawings, general provisions of the Contract, including General and Supplementary Conditions, and Division-1 Specification Sections and Division 15 (20) Specification Sections, apply to work of this Section.

1.02 ACCEPTABLE PROVIDERS:

- A. Systems furnished and installed by the following approved national manufacturers and/or their authorized representatives are acceptable subject to full compliance with the contract documents.

Edit list below to suit project.

ES2 is approved for all conditioned facilities.

1. Engineered Systems & Energy Solutions, Inc. (ES2), Jesse Gentling – jgentling@es2ok.com 405-595-9728.

Intelli-Building Controls and Solutions is approved for all conditioned facilities.

2. intelli-building Controls & Solutions, LLC, Tom Franzo – tom@intelli-building.com 312-802-7134, 773-299-1903.

Industrial Controls & Electrical is **required** for controlling ventilation in ambient facilities and is **approved** for controlling office areas and full building conditioning.

3. Industrial Controls & Electrical (ICE), Clint Benedetto. Clint@ice-electric.com 731-285-8863.

1.03 WORK INCLUDED:

- A. The contractor shall provide the following:

1. Contractor must coordinate with the owner's technology team regarding approved design for the selected providers system including owners security processes.
2. Provide a fully integrated Building Automation System (BAS), UL listed, incorporating direct digital control (DDC) for energy management, equipment monitoring and temperature control.
3. Provide all wiring, conduit, panels, dampers, sensors, devices, etc. as required for a complete system as required to accomplish the operating sequences identified herein.
4. Provide all final electrical connections to each DDC controller. Perform all wiring in accordance with all local and national codes.
5. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC controllers.

1.04 GENERAL SYSTEM DESCRIPTION:

- A. A primary building supervisory controller using HTML5 processing shall be used for the building controller and management of equipment level devices using Building Automation Controls Network (BACnet) and Modbus protocols. The system shall integrate multiple building functions including equipment supervision and control, alarm management, energy management and historical data collection.
 1. Main controllers shall be located in main office area as directed and coordinated by owner during shop drawing review. Secondary controllers, if required, will be located in secured rooms within remote offices as directed and coordinated by owner during shop drawing review.
- B. The system equipment shall include a combination of application specific controllers and terminal equipment controllers. The installed system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC controllers and operator devices. Provide capacity for all equipment provided under this project, plus an additional 25% for future use.
- C. System architectural design shall eliminate dependence upon any single device for control execution and alarm reporting. Each DDC controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices. DDC controllers shall be able to access any data from or send control commands and alarms directly to any other DDC controller or combination of controllers on the network without dependence upon a central processing device.
- D. Communication between the control panels shall be over the high-speed Ethernet local area network (LAN) within the building. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application specific controllers shall be constantly scanned by the network controllers to update point information and alarm information. Communication between control panels shall utilize BACNet protocol (a combination of MSTP, ethernet and IP).
- E. Packaged unitary rooftop units shall be provided with native BACnet unitary controllers as part of system HVAC equipment provided by others under owner national accounts. The BAS system shall fully integrate with this equipment by others to accomplish the system operating sequences as defined herein. Contractor is responsible to familiarize themselves with the capabilities and/or limitations of the control points and configurable sequences available from the equipment manufacturer and is responsible for final setup and setpoints.

- F. HVLS fans will be provided with manufacturer's standard control system and a BACnet communication interface card. HVLS controls shall be integrated into the BAS systems for central monitoring and control. HVLS fans shall also be interlocked with fire alarm system to shut down on trouble signal as required to meet NFPA13.
- G. Access shall be provided via methods pre-approved by owners technology team and in accordance with owners security processes using a unique URL that will allow access directly to the BAS system using tenant determined methods.
1. The graphic interface shall be similar to a conventional workstation interface with full color graphics incorporating dynamic points including temperatures, damper positions, etc. and ability to change setpoints, access alarms and change the time-of-day schedules.
 2. Graphic interface shall be available for users to view the general building plans with current operating parameters and conditions in each space and with links to pages for various equipment items and systems serving those spaces.
 3. Graphic interface shall be available for users to view each mechanical system and sub-system including each packaged rooftop unit, terminal unit, exhaust fan, etc. with links to detailed screens for related equipment and links to text screens of control sequences for the equipment shown. The graphics for each system shall represent in a general way the arrangement of major pieces of equipment within each space.
 4. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention. Colors shall be utilized throughout the graphics to allow the operator to quickly identify a value that is out of range for normal operation. Animation shall be used to visually indicate run status of each component (i.e. spinning fans, dampers open/closed, etc.), and include real-time conditions at each component.
 5. Summary pages shall be developed that allows the operator to quickly determine the operating status of equipment. Information shall include equipment name, operational status, space temperature, fan status and discharge air temperature as applicable.
 6. Include a target button on the Home Page graphic that will automatically display the Sequences of Operation for this project for historical reference. The method of display may be either in text graphic or other form acceptable to owner. The text shall be modified at the Acceptance of the project to reflect any changes that occurred in the Sequence from the time of submittal to the finalization of the software.
 - a. Target buttons at each sublevel screen shall be included which will automatically display the Sequence of Operations for just the portion of the system displayed.
 7. A target button shall be included on the Home graphic that will automatically display the O & M data for the project. The method of display may be either in text graphic or other form acceptable to owner. O & M data sheets shall include identifying marks which correspond to labels on other graphic screens, allowing an operator to determine the correct data sheet for a particular device in the system.
 8. Final approval of graphic interface shall be subsequent to review between

Engineer and Owner. Modifications shall be made upon request.

1.05 SYSTEM COMMISSIONING:

- A. Contractor shall execute functional performance testing of all systems and control sequences and fully commission the control system independently, prior to final commissioning and punch list by Owner and engineer or independent commissioning agent (Cx) if applicable to project. System commissioning by contractor shall include verification and documentation of all sequences of operation.
 - 1. Submit verification forms and documentation for approval by the engineer prior to beginning the commissioning process.
- B. At the completion of system installation, demonstrate to the Owner and Engineer that all sequences are functioning correctly, and explain to the Owner's personnel the step-by-step operation of starting, running, and stopping of all equipment and the maintenance of the controls.

1.06 STANDARD REQUIREMENTS:

- A. Provide system warranty for period and coverages in accordance with national account agreements.
- B. Extended service and preventative maintenance agreements shall be in accordance with national account agreements.
- C. Owner training including content and extent shall be in accordance with national account agreements.
- D. Provide multilevel password access protection in accordance with national account agreements to allow the owner to limit workstation control, display and data base manipulation capabilities as appropriate for each user, based upon an assigned password.
- E. Establish data trending as requested by Owner's facility representative at the time of completion and in accordance with national account agreements.
- F. Set up building occupancy schedules as defined by Owner's representative and in accordance with national account agreements including weekday, weekend, and holiday schedules. Multiple occupancy schedule spreadsheets may be required for different units of the building including separation of warehouse and office areas. Consult the owner for specific building schedules. Refer to Article 3.01 for standard space setpoints.
- G. Following commissioning and the date of final acceptance by the Owner, provide final record documentation for future reference by the owner in accordance with national account agreements. Provide software and firmware licensing agreement documentation as part of record documents.

PART 2 - PRODUCTS

2.01 FIELD DEVICES:

- A. TEMPERATURE SENSORS:
 - 1. Shall be the manufacturer's standard sensors suitable for the controller and the

application and meeting the accuracy and performance requirements of the sequence of operation.

2. Space temperature sensor covers shall be durable, impact resistant material finished in acceptable color. Provide clear, locking cover for all thermostats.
3. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed and equipped with solar shields.
4. Duct mount sensors shall be mounted through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A seal shall be used on the sensor assembly to prevent air leaks.

B. HUMIDITY SENSORS:

1. Humidity sensors shall utilize an all polymer, capacitive humidity sensing element to measure the relative humidity (RH) over the entire range 0% to 100% RH, and send a proportional 0-10 Vdc or 0-5 Vdc signal to the system's controller.
2. Humidity sensor shall be resistant to corrosion in harsh environments and shall have no minimum air flow requirements.
3. Humidity sensor shall have an accuracy of $\pm 3\%$ RH for 5-95% RH and $\pm 5\%$ RH for 0-5% and 95-100% RH.

C. CARBON DIOXIDE SENSORS:

1. Provide manufacturer's standard sensors suitable for the demand control of ventilation.
 - a. Molded plastic enclosure suitable for wall mounting, to reliably and accurately measuring and transmitting CO2 levels.
 - b. Rating: 0 to 5,000 ppm; operating 0 deg F to 120 deg F
 - c. Range: 0 - 2,000 ppm / 0 - 5,000 ppm (user selectable)
 - d. Accuracy: +/- 50 ppm.
 - e. Output: 0 - 10 Vdc, 0 - 20 mA or 4 - 20 mA

D. DEVICE LABELING:

1. On face of each thermostat or temperature sensor, provide adhesive film label indicating designation of specific unit it controls. Labels shall be machine printed in black, by thermal transfer or equivalent process, and with 1/4" letter height.
2. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of equipment and each operational device or panel.

E. CONTROL WIRE AND CABLE:

1. General: Provide wire and cable not included as work of another contract.
2. Control wiring:
 - a. All control wiring for Digital or Analog Functions: shielded 2 or 3 wire to match function hardware. 18 AWG minimum,
 - b. Control wiring for 24VAC and 120VAC control shall be minimum 14 gauge.
 - c. Control wire or cable: shall be installed in accordance with Division 26 Specification.
 - d. Do not install Class 2 wiring in conduit with Class 1 wiring.
3. All branch and trunk wire and cable installed in return air spaces above ceilings shall be installed in conduit or shall be plenum rated for the duty.
4. Label all wiring, including within factory-fabricated panels, within 2" of termination. All labels shall be self-laminating polyester. Do not use handwritten labels.

5. All network cabling shall be provided in a color different than that used by Owner.

F. SMOKE DETECTORS

1. Furnished and installed by packaged rooftop unit manufacturer at all unit locations.

PART 3 - SEQUENCE OF OPERATION

- 3.01 The sequences described herein shall be strictly adhered to as to the scope of the operation. All required devices and programming to accomplish these sequences shall be furnished whether directly specified or not.

A. General:

1. All setpoints indicated below are to be adjustable.
2. All systems to incorporate provisions for unoccupied cycle set-back and set-up temperature setpoints.
3. All air systems to incorporate morning warm-up and morning cool-down cycles when switching from unoccupied cycle to occupied cycle. Units shall start and run on a fully recirculating basis until such time as a preset space temperature is attained, at which time, the outside air damper shall open to minimum position and the discharge air temperature/s shall be placed under automatic control as indicated below.

B. Scheduling:

Confirm scheduling with design project manager. Schedules below are a baseline and the schedules are easily configurable in the field after commissioning.

1. Office and Support Areas:
 - a. Building "Occupied" periods:
 - (1) Monday thru Saturday: 6:00 am to 6:00 pm
 - (2) Space temperature set point for all areas shall be 75°F (cooling), 72°F (heating).
 - b. Building "Unoccupied" period: All other times not listed as "Occupied."
 - (1) Space temperature set point for all areas shall be 80°F (cooling), 65°F (heating), unless otherwise specified.
 - c. Occupant 2-hour forced override shall be provided via space temperature sensor buttons.
2. Warehouse Areas:
 - a. Building "Occupied" periods:
 - (1) Monday thru Sunday: two 12-hour shifts - 24/7 operation
 - (2) Sunday: 6:00 am to 6:00 pm
 - (3) Warehouse temperature setpoint shall be 80°F (cooling), 65°F (heating)
 - b. Building "Unoccupied" period: All other times not listed as "Occupied."
 - (1) Warehouse temperature set point shall be 85°F (cooling), 50°F (heating).

3.02 PACKAGED ROOFTOP HEATING AND COOLING UNITS:

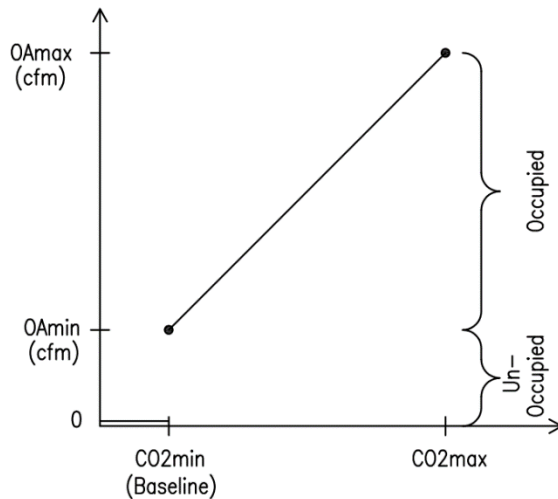
- A. Equipment description:
1. Each unit is provided with a mixed air section (having return and outdoor air dampers), filters, DX cooling coil, hot gas reheat coil for dehumidification (office units only), natural gas heating or multiple-stage electric heating coil (positioned in the reheat position), supply air fan, compressors and condenser coils and fans. Multi-zone VAV system with terminal reheat has parallel fan-powered, electric terminal unit reheat.
- B. RTUs shall be provided with configurable DDC controller by the equipment manufacturer. The manufacturer shall configure controllers from the factory to meet the operating sequences specified herein, i.e. constant volume, single-zone variable air volume (VAV) or multi-zone VAV. BAS contractor shall verify configuration of controller and coordinate with the equipment manufacturer using technical support factory resources via telephone. (On-site support from manufacturer's technicians shall be borne by BAS contractor).
- C. RTU's shall have the ability to operate independently of each other and independently of the Building Automation System (BAS). Control shall revert to the individual unit controller in the event communications with the BAS is lost.
- D. Occupied Mode:
1. Operate unit as needed to maintain occupied set points.
 2. Outdoor and return air dampers modulate as needed, refer to ventilation sequence.
 3. Provide remote occupant unoccupied over-ride capability from any space temperature sensor.
- E. Unoccupied Mode:
1. Operate unit as needed to maintain unoccupied (night setback) set points.
 2. Outdoor air damper will be closed except if unit is in unoccupied economizer free cooling mode.
 3. If there is no call for heating, cooling or dehumidification the unit shall be off.
- F. RTU COMMON SEQUENCES OF OPERATION
1. Space Temperature Sensor Operation
 - a. Each zone shall be provided with a thermostat with slide point or dial adjustment and over-ride button (2-hour, adjustable). Thermostats (by the equipment manufacturer) shall be approved by the Owner.
 - b. Thermostat shall have capability of a 5°F dead band between heating and cooling to meet ASHRAE 90.1.
 2. Dehumidification Sequence (on equipped systems):
 - a. Space humidity shall be monitored continuously via humidistat. Refer to plans for humidistat locations. This contractor shall provide sensors, wiring and installation.
 - b. Sequence shall be available whenever space temperature set point is satisfied.
 - c. Controller shall stage scroll compressors until the humidistat is satisfied. If the room temperature drops below set point during dehumidification sequence, RTU hot gas reheat (SZ VAV) or terminal electric reheat (VAV)

with terminal reheat) shall be enabled for reheating purposes. Once the humidistat is satisfied, the RTU will return to normal operation.

3. Morning Warm-Up Sequence:
 - a. Schedule ½ hour (adjustable) prior to unoccupied-to-occupied changeover.
 - b. Where applicable, VAV boxes are driven to heating CFM position.
 - c. Supply air fan indexed to on.
 - d. Outdoor air dampers held closed.
4. Off Sequence:
 - a. Occurs in the Unoccupied Mode when no heating, cooling or dehumidification demands exist.
 - b. Supply fan is off and the outside air damper is closed.
5. Minimum Outdoor Air Measurement and Control
 - a. During unoccupied mode, outdoor air dampers shall be closed, unless used for free cooling.
 - b. During occupied mode, outdoor air damper shall partially open and return air damper shall be partially closed to maintain minimum ventilation rate indicated on the mechanical schedule.
 - c. Demand Controlled Ventilation: "Densely occupied" spaces are furnished with dedicated rooftop unit and space CO2 sensor (refer to drawings) CO2 sensors shall be continuously polled, and the RTU outdoor air quantity shall be provided in conjunction with CO2 sensor output.
 - (1) For units designated to employ CO2 based demand-controlled ventilation, damper settings shall be set to produce the "area based" ventilation and will modulate open in response to CO2 in the space. If not otherwise defined, "area" ventilation shall be 20% of specified minimum ventilation airflow.
 - (2) CO2 sensor output below setpoint, 800 ppm: Zone airflow requirements shall equal "area" quantity per ASHRAE 62.1.
 - (3) CO2 sensor output above setpoint: Zone ventilation air requirement shall be computed using a linear relationship between CO2 level and ventilation air requirements, where ventilation air requirement is equal to the "area" quantity at 800 ppm and equal to the "area plus people" quantity (the scheduled minimum outside airflow) at 1100 ppm.
 - (4) For spaces with CO2 sensors, the BAS shall monitor the CO2 level and compare it to the threshold setpoint. If the CO2 level exceeds the lower setpoint, the ventilation rate setpoint shall be increased, and the new zone ventilation setpoint shall be used in critical ventilation ratio calculations for the respective rooftop unit. Ventilation rate setpoint shall be decreased back toward scheduled minimum after CO2 levels have dropped below threshold.
 - (5) A PID algorithm shall be applied to optimize the required zone ventilation setpoint in response to deviation from CO2 threshold.
6. Condenser Fan Control
 - a. Condenser fans shall be controlled by RTU manufacturer, (via variable speed drives for units with dehumidification sequence.)
 - b. RTU manufacturer's internal controls shall control the function of the condenser fans in all modes of operation.

7. Coil Suction Temperature Setpoint Reset: By RTU manufacturer's internal controls.
 8. Supply Air Temperature Setpoint Reset:
 - a. During occupied periods with all terminal unit heaters staging or modulating, supply temperature shall be indexed upwards. Add one degree per every 15 minutes that all heaters are staged or modulating, maximum 60 degrees F. As terminal unit heaters stage off, reverse the sequence.
 9. Temperature Protection, Lockouts: By RTU manufacturer's internal controls.
 10. Outputs: All available RTU status and alarm signals shall be provided to the front-end interface.
 11. Smoke detectors: (Furnished and installed by Div.16 (26) on office units). Upon detection of smoke, the outdoor air dampers shall be closed, all operations of the RTU shall be shut down, gas valve in RTU closed, and an alarm shall be sent to the end and to the fire alarm system.
- G. SINGLE ZONE CONSTANT VOLUME SEQUENCE (RTU-x):
1. Occupied Mode – Supply fan will run continuously.
 2. Unoccupied Mode – Supply fan will cycle on a call for heating or cooling.
 3. Cooling mode:
 - a. Compressor capacity shall be modulated as needed to maintain space temperature set point.
 4. Heating Mode:
 - a. Natural gas heating or stages of electric heat shall be indexed via manufacturer's sequence to maintain the space temperature set point.
- H. SINGLE ZONE VARIABLE AIR VOLUME SEQUENCE (RTU-x)
1. Occupied Mode – Supply fan will run continuously.
 2. Unoccupied Mode – Supply fan will cycle on a call for heating or cooling.
 3. Cooling mode:
 - a. Supply fan speed shall be varied to meet space temperature set point.
 - b. Compressor capacity shall be staged as needed to maintain supply air discharge temperature leaving unit at to meet space set point.
 - c. Refer to Section 4.01.B for setpoints.
 4. Heating Mode:
 - a. Supply fan speed shall be varied to meet space temperature set point.
 - b. Natural gas heating or stages of electric heat shall be indexed via manufacturer's sequence to maintain the heating supply air temperature set point.
- I. SINGLE ZONE VARIABLE AIR VOLUME WITH CO2 CONTROL (RTU-x):
1. Occupied Mode – Supply fan will run continuously.
 2. Unoccupied Mode – Supply fan will cycle on a call for heating, cooling or dehumidification.
 3. Cooling mode:

- a. Supply fan speed shall be varied to meet space temperature set point.
 - b. Compressor capacity shall be modulated as needed to maintain supply air discharge temperature leaving unit at set point.
 - c. Refer to Section 4.01.B for setpoints.
4. Heating Mode:
- a. Supply fan speed shall be varied to meet space temperature set point.
 - b. Natural gas heating or stages of electric heat shall be indexed via manufacturer's sequence to maintain the heating supply air temperature set point.
5. Single Zone Demand Controlled Ventilation
- a. Scheduled unoccupied periods: O/A dampers shall be closed.
 - b. Scheduled occupied periods: O/A damper position shall vary linearly with space CO2 sensor output, between "minimum" and "maximum O/A damper positions. Refer to sketch below for reference.



- (1) RTU:
 - (i) CO2min ("Baseline") = measured per item c.
 - (ii) O/Amin = (Determined by Engineer) CFM
 - (iii) CO2max = baseline + 700 ppm
 - (iv) O/Amax = (Determined by Engineer) CFM
 - (2) Coordinate outdoor damper and CO2 sensor output with test and balance contractor. Calibrate the "baseline" CO2 level using CO2 sensor output when space is unoccupied and RTU has been in operation for more than 1 hour.
 - (3) CO2 sensors shall be provided at the following spaces:
 - (i) Training Rooms
 - (ii) Large Conference Rooms
 - (iii) Break Rooms
- J. VARIABLE AIR VOLUME WITH TERMINAL ELECTRIC REHEAT and CO2 CONTROL IN HIGH DENSITY SPACES (RTU-x):
1. Building Occupied Mode:
 - a. The BAS shall index the unit to "building occupied" mode based on the

optimum start/stop program or the time scheduling program. This will enable all components as needed.

2. Supply Air Temperature Setpoint: Cooling and heating shall be controlled to maintain a discharge air temperature of 57 deg. F (adjustable) leaving the unit.
3. Supply Air Temperature Reset: Supply air discharge temperature shall be reset based on outdoor air temperature. Discharge temperature shall reset between 57° F at 55 ° F outdoor temperatures and 62° F at 20° F outdoor temperature.
4. Supply fan operation:
 - a. Fan shall be driven by RTU manufacturer's VFD.
 - b. Occupied Mode: Supply fan will run continuously. The status of the fan shall be monitored via unitary controller output and should operation not be confirmed within two (2) minutes of start-up, an alarm shall be initiated.
 - c. When the system is indexed to occupied mode, the fan shall be ramped up in speed until the duct static pressure set point is met.
5. Unoccupied Mode: Supply fan will cycle on a call for heating, cooling or dehumidification.
6. Static Pressure Sensors: Locate in ductwork near end of supply main. The BAS shall trend this sensor and at the end of six months, this contractor shall issue a report of the trends to the Owner confirming that static pressure reset is operating per ASHRAE 90.1 requirements.
7. Fan speed zone reset control:
 - a. Baseline: Setpoint nominal 0.8 in.w.c.
 - b. Reset: The BAS shall monitor the damper positions of all VAV terminal units served by the RTU. The supply fan static pressure setpoint shall be adjusted down by 0.1 in.w.c. every 10 minutes as long as no damper position is greater than 80% or until the system reaches the minimum static pressure setpoint 0.5 in.w.c. When any damper position is greater than 95% open, the static pressure setpoint shall be increased by 0.1" wc every 10 minutes until no damper position is greater than 95% or until the system reaches the maximum static pressure setpoint of 1.5 in.w.c.
8. Discharge static pressure limit safety: Set manufacturers static pressure high limit safety device to stop the supply fan whenever fan discharge pressure rises above 2.5 in.w.c.
9. Cooling mode:
 - a. Supply fan speed shall be varied to meet duct static pressure setpoint.
 - b. Compressor capacity shall be modulated as needed to maintain supply air discharge temperature leaving unit at set point.
 - c. Supply air temperature reset sequence: If all terminal units are a minimum position, supply air temperature shall be reset higher to avoid terminal reheat operation per ASHRAE Standard 90.1.
10. Heating Mode:
 - a. Stages of electric heat shall be indexed as needed to maintain supply air discharge temperature at set point.

3.03 VARIABLE VOLUME TERMINAL UNITS (FPB-x):

- A. Terminal Unit Controller: The VAV terminal units shall each be controlled by a dedicated VAV controller. The VAV controller with differential pressure sensor and damper motor shall be furnished to the terminal unit manufacturer for factory mounting. Individual zone temperature set point and control logic shall reside at the zone level, and not be

dependent upon the BAS for control.

- B. Occupancy Determination: "Building occupied" mode shall be determined from the BAS schedule. "Zone occupied" mode shall be determined by local occupancy sensor(s). Zones not having an occupancy sensor shall be indexed to occupied based on the building occupancy schedule.
 - 1. Where more than one occupancy sensor is located within the area served by a single VAV terminal unit, indication of occupancy at any one of the respective sensors shall initiate ventilation control.
- C. Zone Temperature Sensors: Individual zone temperature setpoint and control logic shall reside at the zone level, and not be dependent upon the BAS for control. Zone temperature sensor shall include a setpoint slider knob. Room setpoint range shall be limited in software. Initial setting shall be +/- 3°F.
- D. Calibration: The DDC VAV controller shall automatically recalibrate its air flow sensing and air valve position feedback systems on a scheduled weekly basis.
- E. Setpoints: Separate heating & cooling setpoints will exist for building occupied, zone occupied and unoccupied mode.
- F. As the space temperature rises above the cooling setpoint, the terminal unit damper shall modulate to its maximum CFM. As the space temperature falls below the cooling setpoint, the terminal unit damper shall modulate to its minimum cooling CFM. Before heating is initiated, the VAV controller enters a 2 deg F (adj) no-load dead band. As the space temperature continues to fall, the terminal unit electric heater shall be staged or modulated (as scheduled) to maintain space temperature at setpoint. If the discharge air temperature is met and the space temperature continues to fall, the terminal unit damper shall modulate towards its maximum heating position (scheduled.) Upon a rise in space temperature, this sequence shall be reversed.
- G. During building "unoccupied" periods, the variable volume terminal unit damper shall remain at its minimum position. If the space temperature in any area reaches either of the unoccupied space temperature set points, the BAS shall start the respective air handling unit and the variable volume terminal unit damper shall modulate to maintain unoccupied space temperature set point, but only until the space temperature increases 3° F above the unoccupied space temperature set point.

3.04 ELECTRIC UNIT HEATERS (EWH-x, EUH-x):

- A. Electric unit heaters shall be provided with integral or remote, wall-mounted line voltage temperature control by unit manufacturer. No BAS interface required.

3.05 TOILET ROOM and LOCKER ROOM EXHAUST FANS (EF-x):

- A. Fans shall be on during occupied hours and off during unoccupied hours, controlled by the BAS. Provide start/stop and status on graphics.

3.06 GUARDHOUSE

- A. Split system heating and cooling and supplemental cabinet heaters shall be controlled by local or integral thermostat control. No BAS interface required.

3.07 PUMPHOUSE EXHAUST FANS (EF-x):

- A. Fans shall be enabled and motorized damper at intake opened based upon space temperature. For diesel fire pump side of pumphouse, motorized damper shall also be interlocked with operation of fire pump to provide combustion air. No BAS interface required.

3.08 MISCELLANEOUS FANS:

- A. Battery charging exhaust fan (EF-x):
 - 1. Fan shall operate continuously.
- B. Welding exhaust fan (EF-x):
 - 1. Fan shall be manually switched via motor starter on wall within Welding Area.

3.09 GENERATOR

- A. No BAS interface required.

3.10 FIRE ALARM SYSTEM

- A. Upon fire alarm signal in office area, fire alarm system shall shutdown RTU's.

3.11 LIGHTING CONTROL SYSTEM INTERFACE

- A. No BAS interface required.

3.12 MONITORING VISUALIZATION SYSTEM (MVS)

- A. No BAS interface required at this time. System design allows output of data for management operational analysis. Owner may integrate at a later date.

This specification section will only be applied for Midwest or northern regional projects requiring snow melt systems in pedestrian walkways.

3.13 SNOW MELT SYSTEM BOILERS and PUMPS:

- A. BAS shall enable snow melt system pumps below exterior temperature of 35°F (adjustable) and once enabled, pump operation shall be disabled once exterior temperature rises above 40°F.
- B. BAS shall enable boiler operation below exterior temperature of 35°F (adjustable). Boiler shall be controlled via manufacturer's integral controller. Once enabled, boiler operation shall be disabled above exterior temperature of 40°F.

END OF SECTION

SECTION 15992 (230913) - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control panels.
- B. Control dampers.
- C. Operators.
- D. Flow measuring apparatus.
- E. Humidistats.
- F. Input/Output sensors and transmitters.
- G. Output control devices.
- H. Power Supplies.
- I. Thermostats.
- J. Weather stations.

1.2 DEFINITIONS

- A. BAS: Building Automation System.
- B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations
- C. DDC: Direct Digital Control.
- D. EPDM: Ethylene Propylene Diene Monomer.
- E. High voltage: 50 volts or higher.
- F. Low voltage: Below 50 volts.
- G. PTFE: Polytetrafluoroethylene.
- H. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Reference Division 23 Section "Electrical Coordination for Mechanical Equipment" for contractor responsibilities.

- B. BAS Contractor:
 1. Installation of the BAS shall be by the BAS Contractor or his subcontractors.
 2. Low voltage control wiring.
 3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.
 4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
 5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
 6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.
 7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.
 8. Perform startup and demonstration services as specified in Section "Direct Digital Control for HVAC".
- C. Sheet Metal Contractor:
 1. Installation of automatic control dampers, smoke control dampers, and necessary blank off plates.
 2. Access doors where and as required.
- D. Mechanical Contractor:
 1. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.

1.4 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include dimensions, capacities, size, performance characteristics, electrical characteristics, and finishes of materials.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Manufacturer's Instructions: Provide for all manufactured components.
- E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
- G. Warranty: Submit manufacturer warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Measurement devices and sensors shall be calibrated using NIST traceable standards.

1.6 WARRANTY

- A. Correct defective Work within a one year period after Substantial Completion.
- B. Provide extended warranty for control devices and equipment as specified herein.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

- A. Construction:
 - 1. Panel shall be UL 508A listed.
 - 2. NEMA 250, general purpose utility enclosures with enameled finished face panel.
 - 3. NEMA 4X utility enclosure for outdoor or wash-down applications.
 - 4. Provide common keying for all panels.

2.2 CONTROL DAMPERS

- A. Dampers shall be factory fabricated and sized as shown on drawings and as specified.
- B. Individual damper sections shall not be larger than 48 inches x 60 inches. Provide a minimum of one damper actuator per section.
- C. Performance: Test in accordance with AMCA 500-D.
 - 1. Pressure Drop: Unless otherwise scheduled or indicated on the Drawings, size control dampers as follows:
 - a. Modulating Dampers: Provide dampers with linear flow characteristics. Size modulating dampers based on the smaller of the following.
 - 1) Maximum velocity of 1,500 feet per minute.
 - 2) Maximum Full-open air pressure drop of 0.1 inches W.C.
 - b. Two Position Dampers: Dampers shall be full duct size and selected to minimize pressure drop.
 - 2. Leakage:
 - a. Motorized dampers for outdoor, exhaust and relief air and for shaft and stairway vents shall be Class I leakage and shall not exceed 4.0 CFM/square foot in full closed position at 1 inch W.G. pressure differential across damper.
 - b. Motorized dampers for other applications shall be Class II leakage.
- D. Frames: Galvanized steel, extruded aluminum, or stainless steel, welded or riveted with corner reinforcement.
 - 1. Use minimum 16 gauge for rectangular dampers.
 - 2. Use minimum 20 gauge for round dampers.
 - 3. For aluminum frames, use 1/8 inch thick material.
 - 4. All damper frames shall have a flange for duct mounting.
 - 5. Reference Part 3 Execution for application of the material type.
- E. Blades: Galvanized steel, extruded aluminum, or stainless steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.
 - 1. Use minimum 16 gauge for rectangular dampers.

2. Use minimum 16 gauge for round dampers.
 3. For aluminum blades, use 1/8 inch thick material.
 4. The blades shall be suitable for the air velocities to be encountered in the system.
 5. Dampers longer than the maximum blade length shall be fabricated in sections.
 6. Reference Part 3 Execution for application of the material type.
- F. Blade Seals: Synthetic elastomeric inflatable or Neoprene, mechanically attached, field replaceable.
1. Installed along the top and bottom of the frame and on all mating surfaces.
- G. Jamb Seals: Spring stainless steel.
1. Installed inside the frame sides.
- H. Shaft Bearings: One of the following as recommended by manufacturer for the application:
1. Oil impregnated sintered bronze.
 2. Graphite impregnated nylon sleeve with thrust washers at bearings.
 3. Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
 4. Molded synthetic bearings.
- I. Linkage Bearings: One of the following as recommended by manufacturer for the application:
1. Oil impregnated sintered bronze
 2. Graphite impregnated nylon.
- J. Maximum Pressure Differential: 6 inches wg.
- K. Temperature Limits: -40 to 200 degrees F.
- L. Manufacturers:
1. Greenheck.
 2. CESCO.
 3. Pottorff.
 4. Nailor.
 5. Ruskin.
- M. Reference the Damper Schedule in Part 3 for basis of design damper model and material for the application.
- N. Extended Warranty: Control dampers utilized in an economizer assembly shall be covered with minimum 5 year manufacturer warranty, certified to operate through 60,000 damper opening and closing cycles, and certified to meet leakage requirements specified above.

2.3 OPERATORS

- A. General:
1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.
 - a. Reference Part 3 for Damper Operator Voltage Schedule.
 2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
 3. Construction:
 - a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 - b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
 - c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

4. Field Adjustment:
 - a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
 - b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
5. Two-Position Actuators: Single direction, spring return or reversing type. End-switches shall be integral to the actuator to determine actuator status.
6. Modulating Actuators:
 - a. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
 - b. Control Input Signal:
 - 1) Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
 - 2) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-Vdc or 2- to 10-Vdc and 4- to 20-mA signals.
 - 3) Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
 - c. Programmable Multi-Function:
 - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
 - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
 - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
7. Position Feedback:
 - a. Where indicated on the controls drawings, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
 - b. Where indicated on the controls drawings, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
 - c. Actuator shall contain position indicator and graduated scale indicating open and closed travel limits.
8. Integral Overload Protection:
 - a. Provide against overload throughout the entire operating range in both directions.
 - b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
9. Attachment:
 - a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
 - b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.
10. Temperature and Humidity:
 - a. Temperature: Suitable for operating temperature range encountered by application.
 - b. Humidity: Suitable for humidity range encountered by application, non-condensing.
11. Enclosure:
 - a. Suitable for ambient conditions encountered by application.
 - b. NEMA 4 for indoor wash-down or wet locations.
 - c. NEMA 4X, Belimo ZS-300, or equivalent; for outdoor applications.
 - d. Provide actuator enclosure with heater and control where required by application.
12. Stroke Time:
 - a. Coordinate with stroke time indicated on the control drawings.
 - b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.

B. Damper Operators:

1. Controls contractor shall size damper operator.
2. Sizing: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - b. Provide one operator for maximum 20 sq ft damper section or maximum 7 in-lb/sq ft damper area.
3. Fail Positions:
 - a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection. Normal positions are indicated on the control drawings.
 - 1) Return air damper, normally open.
 - 2) Outside air damper, normally closed.
 - 3) Exhaust/Relief air damper, normally closed.
 - b. Operator shall fail in place for all other applications not listed under spring return.

C. Manufacturers:

1. Damper Operators:
 - a. Belimo.
 - b. Honeywell.
 - c. Johnson Controls.
 - d. Schneider Electric (Invensys).
 - e. Siemens.

2.4 FLOW MEASURING APPARATUS

A. Airflow Measuring Stations

1. Sensor quantity and spacing shall comply with the Equal-Area or Log-Tchebycheff method as defined in the ASHRAE Handbook of Fundamentals.
2. Element Construction: Non-corrosive material such as stainless steel, aluminum, or cadmium-plated.
3. Stations and insertion elements utilizing thermal dispersion technology shall utilize hermetically sealed thermistors for each sensor and shall be factory calibrated to NIST traceable standards.
4. Stations and insertion elements using velocity pressure shall be tested and certified in accordance with AMCA 611.
5. Air Inlet Measuring Stations:
 - a. Intended for location within an air inlet to equipment, such as a hood or louver.
 - b. Elements:
 - 1) Element constructed of 316 stainless steel, factory mounted in a circular puck constructed of 14 gauge galvanized steel. Housing shall meet NEMA 1.
 - 2) Element shall not induce a measurable pressure drop, adversely affect fan performance or amplify the sound level within the fan system by its presence in the airstream.
 - 3) Element shall not be affected by the presence of moisture, dirt, or debris in the airstream and shall be unaffected by gusting wind.
 - 4) Density corrected for ambient temperature variances and atmospheric pressure due to altitude.
 - c. Range: Minimum 100 to 2,400 fpm.
 - d. Accuracy: Plus/minus 5.0 percent of reading within the calibrated airflow range.
 - e. Manufacturers:
 - 1) Air Monitor Corporation.
 - 2) Approved equal.
6. Fan Inlet Air Flow Measuring Stations:
 - a. Located in the fan cone inlet with a minimum of two sensing elements.

- b. Traverse Type Elements:
 - 1) The elements shall not induce a measurable pressure drop, adversely affect fan performance or amplify the sound level within the fan system by its presence in the airstream.
 - c. Surface Mount Probes:
 - 1) Thermal Dispersion Type: Two surface mounted thermal dispersion probes mounted on opposite ends of the fan cone shall monitor the airflow.
 - 2) Velocity Pressure Type: The piezometer ring probes shall monitor the pressure difference between the largest and smallest diameters of the inlet cone venturi. High and low pressure sensors shall be connected to flow tubes extending to a termination plate mounted on the fan housing.
 - d. Range: Minimum 100 to 10,000 fpm.
 - e. Accuracy: Plus/minus 3.0 percent of the measured airflow range.
 - f. Manufacturers:
 - 1) Air Monitor Corporation.
 - 2) Ebtron.
 - 3) Greenheck
 - 4) Johnson Controls.
 - 5) Paragon Controls.
 - 6) Ruskin.
 - 7) Sensocon.
7. Duct Air Flow Measuring Stations
- a. Located in a configuration and size equal to that of the duct it is installed.
 - b. The airflow traverse probe shall not induce a measurable pressure drop, nor amplify the sound level within the duct by its presence in the airstream.
 - c. Flow Straightener: Provide flow straightener as required by manufacturer of construction as needed to meet the application.
 - d. Range: Minimum 400 to 4,000 fpm.
 - e. Accuracy: Plus/minus 2.0 percent of the measured airflow.
 - f. Manufacturers:
 - 1) Air Monitor Corporation.
 - 2) Ebtron.
 - 3) Johnson Controls.
 - 4) Paragon Controls.
 - 5) Ruskin.
 - 6) Sensocon.
8. Signal Processor:
- a. Microprocessor-based, field programmable, capable of local display of the measured airflow rate.
 - b. Factory calibrated to NIST traceable standards.
 - c. Accuracy: 0.1 percent of full scale, including linearity, hysteresis, dead band, and repeatability.
 - d. Output: 0 to 10 Vdc or 4-20 mA scaled output signal for remote monitoring.

B. Gas Flow Meter: Furnish gas flow meter as specified in Division 23 Section, "Meters and Gauges for HVAC Piping."

2.5 HUMIDISTATS

A. Room Humidistats:

- 1. Performance Characteristics:
 - a. Throttling range: Adjustable 2 percent relative humidity.
 - b. Accuracy: Plus/minus 3 percent over the operating range.
 - 1) Accuracy shall include temperature effects.
 - c. Operating range: 20 to 80 percent.

- d. Drift: Less than 1 percent per year.
- 2. Construction:
 - a. Wall-mounted enclosure: Plastic, NEMA 250, Type 1.
 - b. Cover: Set point indication.
- 3. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal..

B. Limit Duct Humidistat:

- 1. Insertion, two position switch type.
- 2. Performance Characteristics:
 - a. Throttling range: Adjustable 2 percent relative humidity.
 - b. Accuracy: Plus/minus 5 percent over the operating range.
 - 1) Accuracy shall include temperature effects.
 - c. Operating range:
 - 1) High Limit Type: Minimum 50 to 95 percent.
 - d. Drift: Less than 1 percent per year.
- 3. Construction:
 - a. Enclosure: Metal, NEMA 250, Type 1.

2.6 INPUT/OUTPUT SENSORS AND TRANSMITTERS

A. General:

- 1. Performance Requirements:
 - a. Device must be compatible with project DDC controllers.
 - b. Elements used shall be general-purpose type.
 - c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.
 - 1) Transmitters and transducers shall have offset and span adjustments.
 - 2) Shock and vibration shall not harm the transmitter or transducer.
 - 3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.
 - d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.
- 2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
- 3. Input Power: Low voltage, nominal 24 Vdc.

B. Temperature Sensors:

- 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
- 2. Performance Requirements:
 - a. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degrees F minimum.
 - 4) Heat Dissipation Constant: 2.7 mW per degree C.
 - 5) Drift: 0.04 degree F after 10 years within temperature range.
 - b. RTD:
 - 1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.
 - a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
 - b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.
 - c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degree F.
 - 4) Drift: 0.04 degrees F after 10 years within temperature range.

- c. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
- d. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
- 3. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
- 4. Room Temperature Sensors:
 - a. Construct for surface or wall box, or enclosure with insulated backing suitable for exterior wall mounting.
 - b. Button Sensor for High Finish Spaces: Where noted on the drawings or scheduled, provide cable type, button probe sensor designed for flush mounting in wall or ceiling with the following features:
 - 1) 6 inch leads.
 - 2) 1/2 inch plastic spacer with locking nut.
 - 3) Finish as specified on the drawings. If not specified, provide [Plastic, field paintable][Aluminum][Brass][Stainless Steel] finish.
 - c. Provide the following features:
 - 1) Non-adjustable, blank front panel.
 - 2) Setpoint reset slide switch, dial wheel, or push-button interface with an adjustable temperature range.
 - 3) Individual heating/cooling setpoint slide switches, dial wheel, or push-button interface.
 - 4) Momentary override request push button for activation of after-hours operation.
 - 5) Locking cover where noted on the drawings.
 - 6) Integral digital display with the following:
 - a) Indication of space temperature.
 - b) Setpoint adjustment to accommodate room setpoint.
 - c) Display and control fan operation status.
 - d) Manual occupancy override and indication of occupancy status.
 - e) Controller mode status.
- 5. Temperature Averaging Elements:
 - a. Use on duct sensors for ductwork 10 sq ft or larger.
 - b. Use averaging elements where prone to stratification with sensor length range between 16-22 ft.
 - c. Provide for all mixed air and heating coil discharge sensors regardless of duct size.
- 6. Insertion Elements:
 - a. Use in ducts not affected by temperature stratification or smaller than 10 sq ft.
 - b. Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches for pipe sizes greater than 4 inches.
 - c. Immersion Well Housing: 1/2 inch NPT brass or stainless steel. Stainless steel required for piping 6 inch and larger.

C. Humidity Sensors:

- 1. Elements: Accurate within 3 percent full range with linear output.
 - a. Accuracy shall include temperature effects.
- 2. Resolution: Plus/minus 1 percent.
- 3. Drift: Less than 1 percent full scale per year.
- 4. Sensing Range: 0 to 100 percent relative humidity.
- 5. Room Sensors: Provide housing with integral sensor. Housing shall be plastic, NEMA 250, Type 1. Provide with insulated backing suitable for exterior wall mounting.

- a. Cover: Provide display indicating sensed humidity value.
- 6. Duct Sensors: Insertion type probe with mounting plate. Housing shall be metal, NEMA 250, Type 1.
- 7. Outside Air Sensors: With element guard and mounting plate.

D. Pressure Transmitters:

- 1. Duct Static Pressure:
 - a. Type: Unidirectional, fixed range.
 - a. Performance Characteristics:
 - 1) Accuracy: Plus/minus one percent of full scale.
 - 2) Thermal Effects: Temperature compensated over a minimum 40 to 120 F range. Zero and span shift of plus/minus 0.06 percent or less of full scale per degree F.
 - 3) Sensing Range: Select sensor so that the high end of the nominal sensor range is not less than 150 percent and not more than 300 percent of maximum expected input.
 - 4) Long Term Thermal Stability: Plus/minus one percent full scale per year.
 - b. Construction:
 - 1) Insertion or traverse type sensor suitable for use in flat oval, rectangular, and round duct configurations.
 - 2) Insertion length selected as appropriate for duct size.
 - 3) Traverse sensors shall have at least one pickup point every 6 inches.
 - 4) Element: Variable capacitance sensing technology.
 - 5) Housing: Fire retardant glass-filled polyester, brass, stainless steel, or aluminum.
- 2. Space Static Pressure:
 - a. Type: Bi-directional, fixed range.
 - b. Performance Characteristics:
 - 1) Accuracy: Plus/minus 0.5 percent of full scale.
 - 2) Thermal Effects: Temperature compensated over a minimum 40 to 120 F range. Zero and span shift of plus/minus 0.06 percent or less of full scale per degree F.
 - 3) Sensing Range: Select sensor so that the high end of the nominal sensor range is not less than 150 percent and not more than 300 percent of maximum expected input.
 - 4) Long Term Thermal Stability: Plus/minus 0.5 percent full scale per year.
 - c. Construction:
 - 1) Sensing Port Wall Mounting: Wall plate with integral sensor, sized to fit standard single gang electrical box. Back of sensor plate fitted with union fitting for tubing connection.
 - 2) Sensing Port Ceiling Mounting: Round plate with union fitting for tubing connection.
 - 3) Sensor Element: Variable capacitance sensor technology.
 - 4) Sensor Housing: Fire retardant glass-filled polyester, brass, stainless steel, or aluminum.
- 3. Hydronic Pressure:
 - a. Type: Unidirectional, fixed range.
 - a. General Sensor Performance Characteristics:
 - 1) Accuracy: Plus/minus 1.0 percent of full scale.
 - 2) Thermal Effects: Temperature compensated minimum 30 to 150 F range. Zero and span shift of plus/minus 0.02 percent or less of full scale per degree F
 - 3) Long Term Thermal Stability: Plus/minus 0.5 percent full scale per year.
 - 4) Range: Select sensor so that the scheduled differential pressure setpoint is near the midrange of the sensor pressure range.
 - b. Performance Characteristics for Chiller/Boiler Equipment Differential Pressure:
 - 1) Application: Variable-Primary Flow Systems.
 - 2) Accuracy: Plus/minus 0.05 percent of full scale.
 - 3) Thermal Effects: Temperature compensated minimum 30 to 150 F range. Zero and span shift of plus/minus 0.02 percent or less of full scale per degree F.
 - 4) Long Term Thermal Stability: Plus/minus 0.125 percent full scale per year for minimum 5 years.

- 5) Range: Select sensor so that the scheduled differential pressure setpoint is near the midrange of the sensor pressure range.
 - 6) Manufacturers:
 - a) Rosemount, 3051S
 - b) Approved equal.
 - c. Construction:
 - 1) Suitable for the media temperature and pressure.
 - 2) Chiller/Boiler differential sensor shall have push button zero and span adjustments. No internal mechanical linkages shall be used in the transmitter.
 - 3) Element: Diaphragm type, stainless steel.
 - 4) Housing: Fire retardant glass-filled polyester, stainless steel, or aluminum.
4. Gas Pressure:
- a. Type: Uni-directional, fixed range.
 - b. Performance Characteristics:
 - 1) Accuracy: 0.35% full scale.
 - 2) Operating Temperature Range: -40 to 260 F.
 - 3) Long Term Drift: Plus/minus 0.2% full scale per year.
 - 4) Sensor Output: 4-20 mA.
 - 5) Range: Select sensor so that the scheduled pressure setpoint is near the midrange of the sensor pressure range.
 - c. Construction:
 - 1) Suitable for the media temperature and pressure.
 - 2) Sensor Element: 17-4 PH or 316L stainless steel.
 - 3) Housing: Stainless steel with FKM, EPDM or all welded seals.

E. Equipment Operation Sensors:

- 1. Status Inputs for Airside Equipment:
 - a. Type: Fixed range differential pressure switch with adjustable setpoint.
 - b. Performance Characteristics:
 - 1) Range: Not greater than two times the design fan static pressure.
 - c. Construction:
 - 1) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered.
 - 2) Provide Insertion tube for use in duct configurations. Insertion length selected as appropriate for duct size.
 - 3) Contact Type: Single-pole, single-throw (SPST). Provide multiple poles or throw contacts to meet additional alarms required.
- 2. Status Inputs for Electric Motors:
 - a. Analog Current Transducer:
 - 1) Type: Split core design, cable of being installed or removed without dismantling the primary bus cables.
 - 2) Performance Characteristics:
 - a) Accuracy: Plus/minus 2 percent of selected range.
 - b) Range: Multi-range device, suitable for the amperage encountered with internal zero and span adjustment.
 - 3) Construction:
 - a) 24 V or Self-powered.
 - b) Provide with integral command relay.
 - c) Device shall accept overcurrent up to twice its trip into range.
 - d) Enclosure: UL 94 approved thermoplastic, rated for V-0. No metal parts shall be exposed other than the terminals.
 - b. Binary Current Sensing Relay:
 - 1) Type: Split core with current transformers, adjustable and set to 175 percent of rated motor current.
 - 2) Self-powered with solid-state circuitry and a dry contact output.
 - 3) Adjustable trip point.

- 4) Contact Type: Single-pole, double-throw (SPDT).
- 5) LED indicating the on or off status.
- 6) A conductor of the load shall be passed through the window of the device.
- 7) Device shall accept overcurrent up to twice its trip into range.

F. Leak Detection Sensors

1. Leak detection sensors shall be stand alone as described in Division 23 Section, Common Work Results for HVAC”. Monitor leak detection sensors as noted on the drawings.

G. Carbon Dioxide Sensors:

1. General: Provide non-dispersive infrared (NDIR) CO2 sensors with integral transducers and linear output.
 - a. Linear, CO2 Concentration Range Display: 0 to 2000 ppm.
 - b. Full Scale Accuracy: Plus/minus 75 ppm at concentrations of both 600 and 1,000 ppm when measured at sea level at 77 degrees F.
 - c. Maximum Response Time: 1 minute.
 - d. Analog Output: 0-10 Vdc or 4-20 mA.
 - e. Rated Ambient Conditions:
 - 1) Air Temperature: Range of 32 to 122 degrees F.
 - 2) Relative Humidity: Range of 0 to 95 percent (non-condensing).
2. Calibration Characteristics:
 - a. Factory calibrated and certified by the manufacturer to require calibration not more frequently than once every 5 years.
 - b. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - c. Sensor shall be temperature compensated throughout entire operating range.
 - d. Maximum Drift: 2 percent per year.
3. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - b. Duct Mounting: Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Wall/Surface Mounting: Construct for surface or wall box or enclosure suitable for wall mounting.

2.7 OUTPUT CONTROL DEVICES

A. Control Relays:

1. Provide relay with contact rating, configuration, and coil voltage that is suitable for the application.
2. Provide NEMA 1 enclosure when relay is not installed in a local control panel.
3. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator.
4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus/minus 200 percent minimum from setpoint.

B. Fan Speed Controllers:

1. Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.

2.8 POWER SUPPLIES

A. Reference Division 23 Section “Direct Digital Controls for HVAC” for DC power supply requirements.

B. Control power transformers shall meet NEMA/ANSI standards.

C. Control power transformers shall be UL listed for Class 2 current-limited service or provided with over-current protection on both primary and secondary circuits for Class 2 current-limited service.

- D. Connected load on the transformer shall not exceed 80 percent of the transformer's rated capacity.
- E. The core and windings shall be completely encased in a UL approved thermoplastic. No metal parts shall be exposed other than the terminals.
- F. Performance Characteristics:
 - 1. Accuracy: Plus/minus 1 percent at 5.0 A full scale output.
- G. Provide a disconnect switch for each transformer.

2.9 THERMOSTATS

- A. General:
 - 1. Programmable, with the following features:
 - a. LCD or LED display screen.
 - b. Button or touch-screen Interface.
 - c. 7-day programmable scheduling.
 - d. Temperature information display.
 - e. Setpoint display and adjust.
 - f. Operation mode display and adjust.
 - g. Fan switch setting (Off/Auto/Low/Med/High), configured with the fan system it serves.
 - h. Override.
 - i. Remote temperature sensor interface terminal.
 - j. Lockout.
 - 2. Performance Requirements:
 - a. Accuracy: Plus/minus 1.0 degree F minimum.
 - b. Resolution: Plus/minus 0.2 degrees F.
 - c. Range:
 - 1) Operating Temperature: 32 degrees F to 122 degrees F minimum.
 - 2) Operating Humidity: 0 percent to 95 percent relative humidity, non-condensing.
 - 3) Setpoint Control:
 - a) Cooling: 54 degrees to 100 degrees F.
 - b) Heating: 40 degrees to 90 degrees F.
 - d. Multi-stage as required to match unit cooling and heating stages scheduled on the drawings.
- B. Electric Room Thermostats:
 - 1. Type: 24 volts, two position switch, programmable with setback/setup temperature control.
 - 2. Covers: Locking with set point adjustment and indication.
 - 3. Setpoint functional range: 45 degrees F to 90 degrees F.
- C. Room Thermostat Accessories:
 - 1. Thermostat Covers: Brushed aluminum.
 - 2. Insulating Bases: For thermostats located on exterior walls.
 - 3. Thermostat Guards: Locking transparent plastic mounted on separate base.
 - 4. Adjusting Key: As required for device.
 - 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
 - 6. Integrated sensors: At the contractor's option, the following sensors may be provided with the thermostat in a single device. Refer to the drawings where additional sensors are required. Refer to "Input/Output Sensors" section of this specification for language governing performance of the integrated sensors.
 - a. Occupancy sensor.
 - b. Humidity sensor.
 - c. Carbon dioxide sensor.

- D. Immersion Thermostat:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.

- E. Airstream Thermostat:
 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 2. Averaging service remote bulb element: minimum 7.5 feet or length as required to fit duct.

- F. Electric Low Limit Thermostat:
 1. Snap acting, single pole, single throw, manual or automatic reset switch as indicated on the drawings that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
 - a. Provide double-throw contacts (one for direct equipment control, one for BAS system notification) where additional alarms are scheduled.
 2. Bulb length: Minimum 1 foot for every 1 square foot of coil cross sectional area.
 3. Provide one thermostat for every 20 sq ft of coil surface.
 4. Setpoint shall be adjustable.

- G. Electric High Limit Thermostat:
 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
 2. Bulb length: Minimum 1 foot for every 1 square foot of coil cross sectional area.
 3. Provide one thermostat for every 20 sq ft of coil surface.
 4. Setpoint shall be adjustable.

- H. Fire Thermostats:
 1. UL labeled, factory set in accordance with NFPA 90A.
 2. Normally closed contacts, manual reset.
 3. Fixed or adjustable settings to operate at not less than 75 degrees F above normal maximum operating temperature.

2.10 WEATHER STATIONS

- A. Manufacturers:
 1. Davis Instruments.
 2. Intellisense System
 3. Meter Environment
 4. WeatherHawk

- B. Description:
 1. Weather station shall measure and record wind speed and direction, air temperature and relative humidity, barometric pressure, solar radiation, and rain.
 2. Design weather station for applications with minimal visual impact, high reliability, and a long interval between routine servicing.
 3. Weather station shall use solid-state sensors with no moving parts.
 4. Weather station shall not be impaired by heavy snowfall or freezing conditions that produce rime ice. Provide a thermostatically controlled heater element in the sensor head that keeps the wind sensor elements and the precipitation sensor surface free of snow and ice to minus 62 deg F.
 5. Weather station shall directly connect to host device, or wirelessly connect to a host device through a fully integrated, industrial-grade, 916-MHz spread spectrum radio-frequency communications technology.
 6. RS-232 serial data I/O shall be located on the bottom of the weather station and used as a second serial communications port, for programming and testing the system, or for direct data downloads using a personal computer or personal digital assistant.

7. Weather station shall be provided with a mounting system supplied by weather station manufacturer that is suitable for the installation.

C. Sensor Technology:

1. Wind speed and direction shall use acoustic techniques. Sensor shall consist of three equally spaced ultrasonic transducers in a horizontal plane. Values of any two array paths shall enable computation of both wind speed and direction, and a signal processing technique shall enable the measurement to be calculated using the two array paths of the best quality.
2. Rain shall be measured using a stainless-steel piezometric impact surface that counts the raindrops and measures their acoustic signature, integrating that information to provide a near-real-time value for rainfall amount and rate.
3. Barometric pressure, relative humidity, air temperature, and solar radiation measurements shall be made by scientific grade sensors.
4. Air-temperature and relative-humidity sensors shall be combined in an integrated, user-replaceable unit that requires no calibration.
 - a. Relative humidity sensor shall be a thin-polymer, capacitive sensor.
 - b. Air-temperature sensor shall be a capacitive ceramic sensor.
5. Barometric pressure shall be measured with a capacitive silicon, temperature-corrected, strain gage.
6. Solar radiation shall be measured by a silicon pyranometer with a cut filter limiting the spectral exposure to the 300- to 1100-nm wavelength.

D. Performance: Sensors shall have similar performance criteria as specified herein.

1. Air Temperature:
 - a. Range: Minus 40 to 140 deg F.
 - b. Accuracy: Within 0.9 deg F.
 - c. Resolution: 0.1 deg F.
2. Relative Humidity:
 - a. Range: Zero to 100 percent.
 - b. Accuracy: Within 3 percent over the range of zero to 90 percent and within 5 percent between 90 to 100 percent.
 - c. Resolution: 0.1 percent.
3. Barometric Pressure:
 - a. Range: 17.72- to 32.48-in. Hg.
 - b. Accuracy: 0.015-in. Hg between 32 to 86 deg F.
 - c. Resolution: 0.03-in. Hg between minus 40 to 140 deg F.
4. Solar Radiation:
 - a. Spectral Range: 300 to 1100 nm.
 - b. Reproducibility: Within 2 percent.
 - c. Output: 0.2 mV per watts per square meters.
 - d. Range: Zero to 1000 W per square meters.
 - e. Temperature Range: Minus 40 to 130 deg F.
5. Rain:
 - a. Collecting Area: 9.3 sq. in.
 - b. Range: Zero to 7.87 inches per hour.
 - c. Accuracy: Within 5 percent.
 - d. Resolution: 0.001 inch.
6. Wind Direction:
 - a. Azimuth: Zero to 360 degrees.
 - b. Response Time: 250 ms.
 - c. Accuracy: Within 2 degrees.
 - d. Resolution: 1 degree.
7. Wind Speed:
 - a. Range: Zero to 134 mph.
 - b. Response Time: 0.25 second.
 - c. Accuracy: Greater of 0.67 mph or 2 percent.

- d. Resolution: 0.22 mph.
- 8. Data Storage: 60 days of hourly data.
- E. Output Signals:
 - 1. RS-232 or RS-485 serial interface directly from weather station to host.
 - 2. In applications that cannot accept a serial signal, provide a serial-to-analog converter.
 - 3. Serial-to-Analog Converter:
 - a. Serial converter designed to add analog outputs for measuring instruments that have only serial output.
 - b. Configure to give analog outputs from all measuring sensors and calculated parameters.
 - c. Each converter shall have four analog outputs with a 4- to 20-mA signal.
 - d. Provide multiple converters for applications requiring more points.
 - e. Converter requires a 24-V dc power supply.
- F. Communication Interface:
 - 1. Weatherproof serial cables shall be used to connect the RS-232 I/O on the weather station. Cables shall use nickel-plated brass DB-9 connectors for corrosion resistance and include a Sanoprene jacket suitable for both high-ultraviolet and direct-burial environments.
 - 2. An RF4xx spread spectrum radio-frequency transceiver shall be provided with every wireless weather station.
- G. Unit shall be provided with a 120-V ac, 60-Hz power supply, a serial cable, and an antenna.
- H. Software:
 - 1. Data Transfer Protocols, Software, and Data Interface Hardware: Weather stations that communicate using a proprietary protocol shall be provided with a software development kit to enable a qualified software developer in development of software drivers for third-party devices or software.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

- A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
- B. General Workmanship:
 - 1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
 - 2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

3. Install all equipment in readily accessible locations.
4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
5. Install all products in accordance with manufacturer's instructions.

C. Sensors:

1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
2. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate installation of room/space sensors with architect and other trades to ensure a neat and orderly installation.
3. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
4. Sensors used in mixing plenums and hot and cold decks shall be of averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
5. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each square foot of coil area.
6. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 feet downstream.
7. Install temperature, humidity, and smoke detectors for both supply air and return air applications a minimum of 10'-0" downstream or upstream of the air handling unit and prior to any branch duct takeoffs.
8. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
9. Install outdoor air temperature sensors on north wall, complete with sun shield where shown on the plans. If not shown, locate sensors in an accessible location, a minimum of 15 feet away from exhaust or relief air locations.
10. Differential air static pressure.
 - a. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - b. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building. Pipe the high-pressure port to a location suitable to sense common building pressure or as indicated on the drawings.
 - 1) Panel mount the transducer adjacent to its associated building automation system controller. Provide an independent manometer gauge next to transducer for calibration.
 - c. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - d. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - e. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.
11. Adjust flow switch to meet sensitivity required to ensure minimum flow through the equipment.
12. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with adjacent lighting switches and humidistats.
 - a. Install devices to meet ADA requirements unless otherwise noted on the plans.
13. Mount freeze protection thermostats using flanges and element holders.
 - a. Install thermostat completely across the surface the thermostat serves.
14. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
15. Provide separable sockets for liquids and flanges for air bulb elements.

16. Provide guards on thermostats in areas indicated on the drawings.
17. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
18. Install shutoff valves in the high and low pressure reference lines connecting to hydronic pressure sensors and switches. Install a shunt valve across the high and low reference pressure ports for servicing. Valves may be ordered as an integral option with the sensor.

D. Control Dampers:

1. Install dampers with extruded aluminum or stainless steel frames and blades in corrosive environments and areas with high humidity.
2. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
3. Clearance:
 - a. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
 - b. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
4. Service Access:
 - a. Dampers and actuators shall be accessible for visual inspection and service.
 - b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Division 23 Section, "Air Duct Accessories."
5. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting.
6. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
7. Provide mixing dampers of parallel blade construction arranged to mix streams. Where shown on the drawings, provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
8. Provide isolation (two position) dampers of parallel blade construction.
9. Provide opposed blade damper configuration for all other applications.
10. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
11. After installation of low-leakage dampers and seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Operators:

1. Mount and link control damper actuators according to manufacturer's instructions.
 - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - c. Provide all mounting hardware and linkages for actuator installation.
2. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.
3. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer.

F. Control Panels:

1. Install control panels where shown on the drawings and where required to house controllers for the controlled systems and equipment.

2. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
 3. Coordinate 120V power requirements with Division 26 to panels used for the building automation system and transformers for low voltage power to controllers.
- G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- H. Provide an insulation standoff on control devices, cables, and other items that do not require flush mounting to ductwork, piping, or equipment.

3.3 MAINTENANCE

- A. Refer to Division 01 closeout requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

3.4 STARTUP AND DEMONSTRATION

- A. Control Dampers:
1. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
 2. For c dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
 3. Verify that all two-position dampers operate properly and that the normal positions are correct.
 4. Verify that all modulating dampers are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.

3.5 DAMPER SCHEDULE

<u>SERVICE</u>	<u>RUSKIN MODEL</u>	<u>MATERIAL</u>
Outside, Exhaust and Relief		
Air Control, Stairway and Shaft Vents	CD-50	Aluminum
Control	SD-60	Galvanized Steel
All Other	CD-356	Galvanized Steel

3.6 DAMPER OPERATOR VOLTAGE SCHEDULE

<u>SERVICE</u>	<u>VOLTAGE</u>
Interlocked with HVAC fans	120V
Multi-section dampers	120V
Large dampers (> 60 inches in any dimension)	120V
All other operators control wiring	24V

1. Note: Coordinate with Division 26 if 120V power is required for operator to achieve appropriate torque requirements for damper actuation.

END OF SECTION

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SECTION 15996 (230923) - DIRECT-DIGITAL CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. System Description.
- B. Operator Interface.
- C. Controllers.
- D. Electrical Control Power Wiring and Low Voltage Wiring.
- E. Local Area Network.
- F. System Software.
- G. Controller Software.

1.2 REFERENCE STANDARDS

- A. ANSI/CEA 709.1.D - Control Network Protocol Specification; 2014.
- B. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; most current edition.
- C. IEEE C37.90.1 – IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus, most current edition.
- D. IEEE C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits, most current edition.
- E. ISO 7498 – Information Processing Systems – Open System Interconnection – Basis Reference Model, International Standards Organization, most current edition.
- F. NEMA – National Electrical Manufacturers Association.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.4 DEFINITIONS

- A. ASC: Application Specific Controller. Examples include controllers for specific applications (e.g., FCU, VAV box, etc.) that can be configured through any network services software.
- A. ATU: Air Terminal Unit (e.g., VAV boxes, fan-powered boxes, fan coil units).

- B. BAS: Building Automation System.
- C. BTL: BACnet Testing Laboratories. Third party independent testing and listing program for devices which have been tested according to ASHRAE Standard 135.
- D. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations
- E. DDC: Direct Digital Control.
- F. EMT: Electrical Metallic Tubing
- G. High voltage: 50 volts or higher.
- H. IP: Internet Protocol.
- I. LAN: Local Area Network.
- J. VLAN: Virtual Local Area Network.
- K. Low voltage: Below 50 volts.
- A. NiCS: Niagara Compatibility Statement license.
- L. OSI: Open System Interconnection
- M. PC: Personal Computer.
- N. PICS: Protocol Implementation Conformance Statement.
- O. Point: Point is a generic term used to describe a single item of information in a BAS. Points may be further described as input, output, digital, binary, discrete, analog, modulating, internal, external, virtual or global. Each unique point used by digital controllers, or in a BAS, is typically identified by an address.

1.5 CONTRACTOR RESPONSIBILITIES

- A. Reference the following sections for additional contractor responsibilities and coordination:
 1. Division 23 Section "Electrical Coordination for Mechanical Equipment."
 2. Division 23 Section "Commissioning for HVAC."
 3. Division 23 Section "Instrumentation and Control Devices for HVAC."
- B. Reference Part 3 for additional electrical contractor responsibilities for BAS controls.

1.6 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section "General Mechanical Requirements" for submittal procedures.
- B. General:
 1. The drawings and specifications are not intended to show all details. The BAS contractor shall secure satisfactory information before submitting the proposal and include in the proposal a sum

sufficient to cover all items of labor and material required for the complete installation for the devices and system described.

1. Inform Engineer in writing of any deviation in the exhibits submitted from the requirements of the drawings, specifications, and sequences of operations.

C. Product Data:

1. Submit manufacturer technical data for each system component and software module required for a complete installation.
2. Indicate dimensions, weights, and enclosure construction for all BAS distributed controllers.
2. Submit technical data on all new software supplied including description of functions performed by software and location within the system where software shall reside. Include all software licensing agreements.
3. Submit the PICS for each BACnet device used in the BAS.
4. Submit the NiCS for each type of Niagara station in the BAS.

D. Power and Communication Wiring Transient Protection:

1. Submit catalog data sheets providing evidence that all BAS products offered by the manufacturer are tested and comply with IEEE C62.41.2.
2. Testing shall include power and communication trunk wiring.
3. Compliance with IEEE C62.41.2 shall imply conformance with IEEE C37.90.1 based on the stated position of ANSI and IEEE.

E. Shop Drawings:

1. Submit a trunk cable schematic showing locations of all programmable control units, controllers, and workstations, with associated network wiring.
 - a. Indicate equipment served by each controller on the diagram.
 - b. Indicate switches, power requirements to each controller, and daisy chained controllers.
3. Submit detailed schematic control drawings for each controlled device and equipment.
 - c. Reference all control components to manufacturer make and model number.
 - d. Include all control and power wiring with termination point (controller and terminal number).
 - e. Include clearly indicated and written sequences of operation referenced to specific control components (e.g., "shall modulate valve V-3").
 - f. Include default position (e.g., N.O., N.C., etc.) for all components where applicable.
 - g. Clearly differentiate between existing components and new components.
 - a. Include detailed wiring diagrams showing methods of connections to VFDs, motor starters, energy meters, and all other devices, and all other field wiring necessary for system installation.
 - b. The use of "typicals" will be allowed where appropriate.
2. Submit detailed drawings for each individual BAS distributed controller.
 - a. Include controller identification.
 - b. Include components included in the controller.
 - c. Include numbering of terminals and communications ports.
 - d. List connected data points, including connected control unit and input device.
 - e. Include type of cable connected to each terminal port.
 - f. Identify specific field devices wired to each terminal including identification of each field device and application.
 - g. Clearly differentiate between existing controllers and new controllers.
 - h. Indicate source (electrical panel ID) of 120V power to each panel to which 120V power is connected.
 - i. Indicate method of connecting controller to equipment supplied by others and to existing communications networks.
3. Submit floor plans that indicate the following:
 - a. Location of all new BAS distributed controllers and control panels.
 - b. Routing of all new building level network communications wiring not located in mechanical and electrical rooms.

- c. Routing of wiring to controllers, sensors, and control points not located in mechanical and electrical rooms.
 - d. Location of building system connection to Owner's campus wide data network.
 - 4. Submit methods and materials used to integrate into existing networks.
 - 5. All control drawings and schematics shall be generated using AutoCAD software or equivalent. All project drawings shall be supplied to the Owner in a format as desired by the Owner upon project completion.
 - 4. Submit system identification nomenclature.
 - a. Nomenclature shall be consistent throughout the network and consistent with any existing networks that are integrated. If not defined, nomenclature shall be similar to the point names shown on the drawings.
 - b. Object name and ID number shall be unique within a control device.
 - c. Control device name and ID number shall be unique within the network.
 - d. Network number shall be unique within the BAS.
 - 6. Indicate system graphics indicating monitored systems, data (connected and calculated) and operator notations.
 - a. Submit example graphic visualizations and screenshots for the BAS. At a minimum, submit examples for major HVAC equipment components, including chillers, boilers, air handling units, fan coil units, heat pumps, fans, etc.
 - b. Font size and type shall be manufacturer standard.
 - c. Provide graphics demonstration package in a format as desired by the Owner.
 - 7. Indicate description and sequence of operation of operating, user, and application software.
- F. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- G. Manufacturer's qualification statement.
- H. Installer's qualification statement.
- I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include submittals data in final "Record Documents" form.
 - 3. All additions or changes to the BAS during the course of construction shall be reflected upon the drawings and submitted to the Engineer before project close-out.
- J. Testing and Commissioning Reports and Checklists: Submit completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3, Startup and Demonstration.
- K. Operation and Maintenance Data:
 - 1. Include maintenance data and recommended spare parts list for digital control equipment and control components.
 - 2. Include trouble-shooting maintenance guides.
 - 3. Include interconnection wiring diagrams showing complete field installed systems with identified and numbered system components and devices.
 - 4. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 5. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 6. Include a maintenance manual which contains the information listed above, product data, shop drawings, final software code for sequences of operation and maintenance data in accordance with requirements of Division 01.
 - 7. Include logbook for documentation of software updates and patches applied BAS for the time period included in the software licensing agreement.

8. Provide names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

L. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

M. Maintenance Materials:

1. Refer to Division 01 for additional provisions.
2. Extra Stock Materials: Two printer cartridges and cartons of printer paper.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

C. BACnet devices used in the BAS shall be BTL listed according to its device profile.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

E. Installer Qualifications: Company specializing in performing the work of the type specified and with minimum documented experience as follows:

1. All personnel of the BAS Contractor shall have a minimum of three years of experience within their appropriate trades.
2. All subcontractors utilized by the BAS Contractor shall have a minimum of five years experience within their appropriate trades.

1.8 WARRANTY

A. Refer to Division 01 for additional project warranty requirements.

B. Labor and materials for the BAS specified shall be warranted free from defects in workmanship and material for a period of 1 year after Substantial Completion and system acceptance.

C. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.

D. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

E. Provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

F. Provide five year manufacturer's warranty for field programmable micro-processor based units.

G. Special warranty on instrumentation:

1. All instrumentation shall be covered by manufacturer's transferable one-year "No Fault" warranty. If manufacturer warranty is not available, the BAS installer shall provide the same.

1.9 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 - 1. Limiting use of software to equipment provided under these specifications.
 - 2. Limiting copying.
 - 3. Preserving confidentiality.
 - 4. Prohibiting transfer to a third party.
- B. Software provider shall provide software updates and patches to the BAS as part of the software licensing agreement as the updates and patches are released. If any security vulnerabilities are discovered by the provider, the provider shall notify the client within five business days.
- C. Ownership of Proprietary Material: Project-specific software and documentation shall become Owner's property upon project completion. This includes, but is not limited to the following:
 - 1. Graphics.
 - 2. Record drawings.
 - 3. Database.
 - 4. Application programming code.
 - 5. Documentation.

PART 2 - PRODUCTS

1.1 PRE-APPROVED MANUFACTURERS

- A. Engineered Systems & Energy Solutions, Inc. (ES2), Jesse Gentling – jgentling@es2ok.com 405-595-9728.
 - B. Intelli-building Controls & Solutions, LLC, Tom Franzo – tom@intelli-building.com 312-802-7134, 773-299-1903.
 - C. Johnson Controls, Metasys.
 - D. Industrial Controls & Electrical (ICE), Clint Benedetto. Clint@ice-electric.com 731-285-8863.
- A. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, building controllers, custom application controllers, and application specific controllers. All other products specified under Division 23 Section "Instrumentation and Control Devices for HVAC" need not be manufactured by the above manufacturers.

2.2 SYSTEM DESCRIPTION

- A. General:
 - 1. The BAS shall consist of all necessary hardware and software to perform the control sequences of operation as called for in the Specifications and Drawings. Contractor shall install and commission all necessary devices to ensure a reliable and stable network.
 - 2. System design is based on a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
 - 3. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

4. The BAS shall be capable of integrating multiple devices, sensors, and functions from multiple control vendors into a common front end, including equipment supervision and control, alarm management, energy management, and trend data collection.
5. The BAS shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.
6. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

B. Local Area Network:

1. The BAS shall be set up using a VLAN connection into the Owner's internet or enterprise intranet. Verify with owner, The VLAN shall be digitally separate from all other networks and shall share a common physical cabling backbone. Coordinate with the Owner to configure Ethernet and IP router switches to accommodate the VLAN.

C. Network Architecture: The BAS network architecture shall be based upon the OSI basic reference model in accordance with ISO 7498.

1. Application/Network Layer:
 - a. BACnet protocol complying with ASHRAE Standard 135.
2. Physical/Data Link Layer:
 - a. Hard-wired type:
 - 1) Ethernet according to ISO 8802-2 protocol.
 - 2) EIA-485 Twisted Cable Pair according to Master Slave/Token-Passing (MS/TP) protocol.
3. Communication between operator workstation(s) and building controller(s):
 - a. Ethernet.
 - b. MS/TP.
 - c. Zigbee.
 - d. Wi-Fi.
4. Communication between building controller(s) and application specific and custom application controllers:
 - a. MS/TP.
 - b. PTP.
 - c. Zigbee.
 - d. Wi-Fi.

D. Web Services Enabled Network:

1. The network shall be capable of being accessed remotely over the internet via a virtual link according to Internet Protocol.
2. System software shall be based on a client/server architecture, designed around the open standards of web technology. The BAS server shall be accessed using a web browser over the BAS network, Owner's LAN, and remotely over the Internet (through the Owner's LAN).
3. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming. Connection shall be browser agnostic.
4. Software applications shall be designed and optimized for hand-held device interface (e.g., tablets, smart phones, etc.). Interface shall grant visibility and control access, at a minimum, to the following data: Summary, Alarm, Setpoints, Status, Schedule, and Trending.

E. Network Integration:

1. The BAS network shall be integrated with other automation networks controlled by the Owner. Coordinate with the Owner's information technology (IT) department for networks that shall be integrated.
2. Provide gateways or other integration devices across networks with different communication protocol to provide a single network visibility and interoperability at the operator workstation. Coordinate communication protocol with each automation system specified.

3. Interoperable networks shall be capable of sharing all point and point information across networks to a single BAS front end.
4. Interoperable networks shall be capable of automatically downloading application program changes.
5. For integrated networks that cannot automatically download application program changes, provide a link to the Controller Manual Download Schedule, as defined in the submittals section of Part 1 on the BAS front end summary page

F. Network Interoperability:

1. Provide communication between control units over local area network (LAN).
2. Communication services over the LAN shall result in operator interface and value passing that is transparent to the network architecture as follows:
 - a. Connection of an operator interface device to any one controller on the network shall allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the network.
 - b. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the network. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform network value passing.

2.3 OPERATOR INTERFACE

A. General:

1. The Operator Interface shall provide overall BAS supervision and system software interface. Communications from the workstation shall be executed directly to and between the integration level building controllers and field level controllers.
2. The operator interface shall be capable of command entry, information and alarm management, database management, access of all system data, and be independent of hardware technology.

B. Hardware:

1. Desktop:
 - a. Computer(s) and display(s) to be provided by BAS controls manufacturer.
 - b. PC shall be general purpose and commercially available, with sufficient memory and processing capability to meet the requirements of the BAS.
 - 1) Quantity: 1.
 - 1) Minimum RAM: 4.0 gigabytes.
 - 2) Minimum Processing Speed: Intel i3 Dual Core Microprocessor or better running at no less than 3.0 gigahertz.
 - 3) Minimum Hard Drive Memory: 500 gigabytes.
 - 2) Drives: 32X CD Rom/8X DVD drive.
 - 4) Ports:
 - a) Minimum of 2 USB 2.0 or faster ports on front of tower.
 - b) Minimum of 2 free USB 2.0 or faster ports on rear of tower.
 - b. Monitor: Minimum 17 inch VGA or higher resolution, color graphic LCD or LED monitor with a compatible VGA or higher resolution card.
 - c. Location(s): As directed by the Owner.
 - d. Network Connection:
 - 1) Suitable for network technology provided.
 - 2) Ethernet interface card with minimum Speed: 10/100/1000.
 - 3) Wireless interface card, dual band.
 - e. Standard 101 key keyboard.
 - f. Standard mouse with track wheel.
2. Laptop:

- a. Laptop(s) to be provided by BAS controls manufacturer.
 - b. Laptop shall be general purpose and commercially available, with sufficient memory and processing capability to meet the requirements of the BAS.
 - c. Quantity: 1.
 - c. Minimum RAM: 4.0 Gigabytes.
 - d. Minimum Processing Speed: Intel i3 Dual Core Microprocessor or better running at no less than 3.0 gigahertz.
 - e. Minimum Hard Drive Memory: 500 Gigabyte.
 - f. Drives: External 32X CD/8X DVD drive with USB connection.
 - g. Ports: Minimum of 2 USB 2.0 or faster.
 - h. Display: Minimum 15 inch.
 - i. Network Connection:
 - 1) Suitable for network technology provided.
 - 2) Ethernet interface card with minimum speed: 10/100/1000.
 - 3) Wireless interface card, dual band.
3. System Printer:
- a. Printer(s) to be provided by BAS controls manufacturer.
 - b. Quantity: 1.
 - c. Type: Business/office quality inkjet or laser jet equivalent printer.
 - d. Resolution: Up to 600 x 1200 dots per inch (dpi) black and up to 4800 x 1200 dpi color.
 - e. Minimum Print Speed: Minimum 18 ppm black and 10 ppm color.
 - f. Locations(s): As directed by the Owner.
4. Database Save/Restore/Back-Up:
- a. Back-up copies of all Building Controller and ASC data as well as mass storage for trend logs shall be stored in the mass storage device designated by the Owner.

1.2 CONTROLLERS

C. Building Controllers

- 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - c. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - d. Share data between networked controllers.
 - e. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
 - f. Utilize real-time clock for scheduling.
 - g. Continuously check processor status and memory circuits for abnormal operation.
 - h. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - i. Communication with other network devices to be based on assigned protocol.
 - j. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- 2. Communication:
 - a. Perform routing when connected to a network of custom application and application specific controllers.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 1) Port shall be USB type.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.

- b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
 - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- 7. Surge and Transient Protection:
 - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

D. Custom Application Controllers

- 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked, microprocessor based controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
 - i. Monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.
- 2. Communication:
 - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F and 95 percent RH, non-condensing.
 - b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.

- b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the Digital Panel shall automatically resume full operation without manual intervention.
 - d. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
7. Surge and Transient Protection:
- a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- E. Application Specific Controllers
- 1. General:
 - a. Input Power Requirements: 24Vac.
 - b. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - c. Customized for operation within the confines of equipment served.
 - d. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - e. Communication with other network devices to be based on assigned protocol.
 - 1) Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 - f. Monitor and assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - 2. Communication:
 - a. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within NEMA 4X waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within NEMA 1 dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F and 95 percent RH, non-condensing.
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory. In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention.
 - d. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
 - 7. Surge and Transient Protection:
 - a. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard C62.41.2.
 - b. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- F. Input/Output Interface

1. Hardwired inputs and outputs shall tie into the BAS through building, custom application, or application specific controllers.
2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - c. Universal-type inputs or outputs configurable between binary and analog are acceptable.
3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 Vdc, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 Vdc or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - 1) VAV terminal units.
 - 2) Duct mounted heating coils.
 - 3) Zone dampers.
 - 4) Radiant devices.
 - c. Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.4 ELECTRICAL CONTROL POWER AND LOW VOLTAGE WIRING

- A. Power Wiring: Copper wiring, plenum cable, and raceways shall be as specified in the applicable section of Division 26.
- B. Power and Communication Wiring Transient Protection:
 1. Comply with IEEE C62.41.2.
 2. Communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection required.
 3. Communication circuitry, input/output circuitry, and communication unit shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations.

- a. For systems not complying with this requirement, provide equivalent protection external to the automatic temperature control system controller. Protection shall be provided for the individual communications and input/output terminations for each automatic temperature control system controller.
 - b. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.
- C. Power Supplies:
- 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Supplies shall be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F.
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- D. Power Line Filtering:
- 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.
- E. Input/Output Control Wiring
- 1. Control wiring shall be sized to accommodate the voltage drop associated with the distance between the control device and the controller. Minimum size shall be as specified herein.
 - 2. In all communication conduits, provide one spare twisted pair to be installed, tagged and labeled at each end.
 - 3. Control wiring not installed in conduit shall be UL rated for plenum installation.
 - 4. Ethernet control wiring shall be fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
 - 5. RTD wiring shall be three-wire or four-wire twisted, shielded, minimum number 22 gauge.
 - 6. Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.
 - 7. Binary control function wiring shall be a minimum of number 18 gauge.
 - 8. Analog output control functions shall be a minimum of number 22 gauge, twisted, shielded.
 - 9. Binary input wiring shall be a minimum of number 22 gauge, twisted, shielded.
 - 10. Thermistors shall be equipped with the manufacturer's calibrated lead wiring.
 - 11. 120V control wiring shall be #14 THHN in 3/4 inch conduit. Provide 20% fill extra wire in each conduit.
- F. Splices: Splices in shielded cables shall consist of terminations and the use of shielded cable couplers that maintain the integrity of the shielding.
- G. Conduit and Fittings
- 1. Conduit for Control Wiring, Control Cable and Transmission Cable: EMT with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
 - 2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.

3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.

H. Relays

1. Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.
2. Solid State Relays (SSR):
 - a. Input/output isolation: Greater than 10×10^9 ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz.
 - b. Contact Life: 10×10^6 operations or greater.
 - c. Ambient Temperature Range: Minus 20 to +140 degrees F.
 - d. Input impedance: Not be less than 500 ohms.
 - e. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.
3. Contactors:
 - a. Type: Single coil, electrically operated, mechanically held, double-break, silver-to-silver type protected by arcing contacts.
 - b. Positive locking shall be obtained without the use of hooks, latches, or semi permanent magnets.
 - c. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

2.5 SYSTEM SOFTWARE

A. General:

1. Provide all necessary system software to form a complete operating system for all operator interface devices.
2. System software shall integrate with all controller software and allow management of software applications at the operator workstation.
3. System software display language: English.

B. Device Profile: BACnet devices shall Conform to the following device profiles as specified in ASHRAE/ANSI 135 BACnet Annex L:

1. Operator workstation: BACnet Operator Workstation (B-OWS) or][BACnet Advanced Workstation (B-AWS).
2. Building Controller: BACnet Building Controller (B-C).
3. Advanced Application Controller: BACnet Advanced Application Controller (B-AAC).
4. Application Specific Controller: BACnet Application Specific Controller (B-ASC).

C. Software Programming:

1. Provide programming for the system and adhere to the sequences of operation provided. Provide actions for all possible situations. All other system programming necessary for the operation of the system shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Provide text-based, graphic-based, and parameter-based programming where appropriate.

D. Operating System:

1. Concurrent, multi-tasking capability.
2. Common Software Applications Supported:

- a. Microsoft Windows and Microsoft Office Suite.
 - b. Open platform compatible database: Microsoft Access, Oracle Database, IBM Analytics, or other SQL database software. Proprietary databases shall not be acceptable.
3. Acceptable Operating Systems: Most recent version of operating system.

E. System Graphics:

- 1. Color type, saved in an industry-standard format such as BMP, JPEG, PNG, or GIF.
- 2. Allow simultaneous display for comparison and monitoring of system status.
- 3. Web based graphics shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X, Java Virtual Machine, and Adobe Flash).
- 4. Animate displayed objects by shifting image files of objects based on object status.
- 5. Functionality: Provide method for operator with password to perform the following:
 - a. Move between, change size, and change location of graphic displays.
 - b. Modify on-line.
 - c. View a summary of the most important data for each controlled zone or piece of equipment.
 - d. View a summary of the most important global data for the project, including but not limited to date, day of week, time, outdoor dry bulb temperature, and humidity.
 - e. Use point-and-click navigation between graphic screens.
 - f. Edit setpoints and other specified parameters.
 - g. Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - h. Add, delete, or change dynamic objects consisting of:
 - 1) Analog and binary values.
 - 2) Dynamic text.
 - 3) Static text.
 - 4) Animation files.
 - i. Display graphic file, text, and dynamic object data together on a single graphic. Display all measured and commanded data, setpoints, calculated values, and input and output control points with appropriate engineering units associated with each system schematic.
 - j. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
 - k. Dynamic Data Displays shall be capable of including point data from multiple ASC's.
- 6. Include at least one graphic for each of the following:
 - a. Each piece of equipment.
 - b. Occupied zone.
 - c. Floor plan displays of the building. Indicate summary conditions for each floor.
 - d. Indicate thermal comfort on floor plan using dynamic colors to represent zone temperature relative to zone setpoint.
- 1. Graphic Tree Structure:
 - e. Structure graphic system tree to allow access to individual graphic screens from a macro to a micro level.
 - f. Allow each level of graphic direct access to the graphic screen above and below the graphic screen in the system tree.
 - g. Allow direct access to the main summary graphic screen/map from any individual graphic screen.
- 7. Sequence of Operation Graphics:
 - a. Display the complete Sequence of Operation or include a link to a separate text file that contains the sequence of operation, as submitted by the Contractor and approved by the Engineer with each system schematic view. The Sequence of Operation text shall be in a separate frame above, below, or to the side of the graphic as appropriate for the graphic size and content.
- 8. Custom Graphics Generation Package:
 - a. Allow operator to create, delete, modify, and save custom graphic files and displays. File format of graphics shall be compatible with BAS software.
 - b. Web-based Graphics: HTML graphics to support web browser compatible formats.

- c. The BAS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard components with which custom graphics may be built. Standard components include but are not limited to
 - 1) Air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.).
 - 2) Complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.).
 - 3) Electrical symbols.
 - d. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following
 - 1) Define symbols.
 - 2) Position and size symbols.
 - 3) Define background screens.
 - 4) Define connecting lines and curves.
 - 5) Locate, orient and size descriptive text.
 - 6) Define and display colors for all elements.
 - 7) Establish correlation between symbols or text and associated system points or other displays.
 - 8) Capture or convert graphics from AutoCAD.
 - e. Graphical displays shall be capable of representing a group of objects. Groups shall be capable of representing any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the building.
2. Standard HVAC Graphics Library: Furnish a complete library of standard HVAC equipment graphics and standard symbols for ancillary equipment in a file format compatible with the graphics generation package program. Graphics shall include, but not be limited to, the following:
- a. HVAC Equipment:
 - 1) Air Handlers.
 - 2) Terminal HVAC Units.
 - 3) Fan Coil Units.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Dampers.
 - 3) Ductwork.

F. Workstation System Applications:

- 1. General Application Functions:
 - a. All applications shall be capable of being executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization.
 - b. Allow BAS configuration and future changes or additions by operators with password protection.
 - c. Execute configured processes defined by the user to automatically perform calculations and control routines.
 - d. Process Inputs and Variables: It shall be possible to use any of the following in a configured process:
 - 1) Any system-measured point data or status
 - 2) Any calculated data
 - 3) Any results from other processes
 - 4) Boolean logic operators (and, or)
 - e. Process Triggers: Configured processes may be triggered based on any combination of the following:
 - 1) Time of day
 - 2) Calendar Date
 - 3) Other processes
 - 4) Events (e.g., point alarms)

- f. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASC's. In addition, a single process shall be able to issue commands to points in any and all other ASC's on the local network.
2. Network Configuration:
 - a. Allow for configuration of the BAS network.
 - b. Provide alarm when a break in communication between devices is detected.
 - c. Enable the operator to add, delete, or modify the following:
 - 1) Building controllers and ASC's.
 - 2) Points of any type, point parameters, and tuning constants.
 - d. Provide automatic reconfiguration if any station is added or lost.
 3. Save and Restore:
 - a. Automatic System Database Save and Restore Functions:
 - 1) Store current database copy of each Building Controller on hard disk or server.
 - 2) Backup database on a user adjustable frequency basis. Default frequency shall be monthly.
 - 3) Automatically update upon change in any system panel.
 - 4) In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - b. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - 1) Save database from any system panel.
 - 2) Clear a panel database.
 - 3) Initiate a download of a specified database to any system panel.
 4. On-line Help:
 - a. Include context-sensitive system to assist operator in operation and editing.
 - b. Include topics available for all applications.
 - c. Include relevant screen data provided for particular screen display.
 - d. Include additional help via hypertext.
 5. Security:
 - a. Require user name and password for Operator log-on to view, edit, add, or delete data.
 - b. Include selectable system security for each operator. Support a minimum of five levels of access:
 - 1) Level 1 = Read-only data access and display.
 - 2) Level 2 = Level 1 + scheduling.
 - 3) Level 3 = Level 2 + operator overrides and commands.
 - 4) Level 4 = Level 3 + database generation and modification.
 - 5) Level 5 = Level 4 + Audit trail management.
 - 6) Operators shall be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only the items defined as accessible for the user.
 - 7) Support a minimum of 4 passwords at each Building Controller.
 - c. Allow system supervisor to set passwords and security levels for all other operators.
 - d. Allow operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Include automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. Store all system security data in encrypted format.
 - g. Log all user actions and store data for audit with permission access by system administrator only.
 - 1) Include the modified system.
 - 2) Include the value modified.
 - 3) Include the time of modification.
 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Network connections.

- 4) Building management panels.
 - 5) Controllers.
 - b. Device failure is annunciated to the operator.
7. Alarm Management:
- a. Allow alarm prioritizing to minimize nuisance reporting and to speed operator response to critical alarms.
 - 1) Provide a minimum of three, user definable priority levels.
 - 2) Enable users to manually inhibit alarm reporting for each point.
 - 3) Enable users to manually inhibit nuisance alarm reporting for maintenance or repair work that is scheduled to be performed.
 - 4) Enable user to define conditions under which point changes need to be acknowledged by an operator, and/or logged for analysis at a later date.
 - 5) Allow alarm prioritization to lock out or circumvent other alarms that may be generated as a result of primary alarm.
 - b. Prohibit interference with the ability of the system software to report alarms by either operator activity at the local I/O device, or communications with other system controllers on the network.
 - c. Allow all system objects that are configurable to "alarm in" and "alarm out" of normal state.
 - d. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
 - 5) Alarm delay.
 - e. Alarm Messages:
 - 1) Descriptor: English language. Acronyms or mnemonics for objects in alarm are not acceptable.
 - 2) Recognizable Features:
 - a) Source.
 - b) Location.
 - c) Nature.
 - d) Time and Date.
 - e) Alarm message box to more fully describe the alarm condition or direct operator response.
 - f) Each Alarm messages shall be assignable to any point in the BAS. Alarm messages shall be assignable to multiple points.
 - a) Notification of an alarm override.
 - f. Configurable Alarm Reactions by Workstation and Time of Day:
 - 1) Logging.
 - 2) Printing.
 - 3) Starting programs.
 - 4) Displaying messages.
 - 5) Phone text message.
 - 6) Email.
 - 7) Providing audible annunciation.
 - 8) Displaying specific system graphics.
8. Custom Trend Logs:
- a. Maintain trend information for minimum 365 days.
 - b. Definable for any data object in the system including interval, start time, and stop time.
 - 1) Resolution: Interval periods shall be adjustable down to one minute.
 - 2) Multiple Interval Period: Each trended point shall have the ability to be trended at a different trend interval.
 - c. Trend Data:
 - 1) Sampled and stored on the building controller panel.

- 2) Auto-Delete Period: Software shall be capable of automatically deleting stored trend data after a user-adjustable period of time. Each trended point shall have the ability to have a different auto-delete interval period.
 - 3) Archivable on hard disk or server.
 - 4) Retrievable for use in reports, spreadsheets and standard database programs.
 - 5) Protected and encrypted format to prevent manipulation or editing of historical data and event logs.
- d. Trend Graph Display:
- 1) Group Trend Time Series Plots:
 - a) Provide user-selectable Y-axis points.
 - b) Provide user editable titles, point names, and Y-axis titles.
 - c) Individual trended points shall be able to be grouped into groups of up to four points per plot with up to four plots per page.
 - 2) X-Y Trend Plots:
 - a) User selectable X and Y trend inputs.
 - b) User editable titles, point names, and X and Y-axis titles.
 - c) User selectable time period options:
 - i) 1-day 24-hour period.
 - ii) 1-week 7-day period.
 - iii) 1-month period with appropriate days for the month selected.
 - iv) 1-year period.
 - v) User shall be able to select the beginning and ending period for each X-Y chart, within the time domain of the database being used.
 - vi) User selectable display up to 6 plots per screen in 2 columns.
 - 3) Automatic Scaling: System shall automatically scale the axis on which trends are displayed when multiple points with different trend interval periods are selected for graphical display.
 - 4) Dynamic Update: Trends shall be able to dynamically update at operator-defined intervals.
 - 5) Zoom: Software shall allow zoom-in function for detailed examination of trends.
- e. Numeric Value Display: Software shall display value of any sample on a trend when picked.
9. Alarm and Event Log:
- a. View all system alarms and change of states from any system location.
 - b. List events chronologically.
 - c. List alarm priority.
 - c. Allow operator with proper security to acknowledge and clear alarms. Log operator and time when alarm is acknowledged.
 - d. Archive alarms not cleared by operator to the workstation.
10. Object, Property Status, and Control:
- a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
11. Clock Synchronization:
- a. The real-time clocks in all building control panels and workstations shall be able to automatically synchronize daily from any operator-designated device in the system.
 - b. The system shall automatically adjust for daylight savings and standard time, if applicable.
12. Reports and Logs:
- a. Reporting Package:
 - 1) Allow operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.

- 4) Provide ability to obtain real-time logs of all objects available by type or status such as alarm, lockout, normal, etc.
 - 5) Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - 6) Allow printing on operator command or specific time(s).
 - b. Standard Report Format Options:
 - 1) Objects with current values.
 - 2) Global modification values.
 - 3) Current alarms not locked out.
 - 4) Disabled and overridden objects, points and variables.
 - 5) Objects in manual or automatic alarm lockout.
 - 6) Objects in alarm lockout currently in alarm.
 - 7) Objects currently in override status.
 - 8) Objects in Schedules
 - a) Daily.
 - b) Weekly.
 - c) Holiday.
 - 9) Logs:
 - a) Alarm History.
 - b) System messages.
 - c) System events.
 - d) Trends.
 - c. Custom Report Format Options:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - 8) Point Groups.
 - a) User-selectable.
 - b) Group may be comprised of specific points, group of equipment objects, group of groups, or for the entire facility without restriction due to the hardware configuration of the BAS.
13. Global Modify:
- a. Allow global modification of all editable data. Similar data shall be grouped into logical objects based on building function, mechanical system, building layout, or any other logical grouping of points.
 - b. Allow each common type of equipment to be excluded or included within the global editing process.
 - c. Display status information on all similar points in one global report.
 - d. Allow modification of the following:
 - 1) Individual data point edited.
 - 2) List of all points within the category.
 - 3) Global change field.
 - 4) Copy feature to assist in downloading the new changes.
 - 5) Verification that all changes were completed.
 - e. Include a change-all feature to change all selections.
 - f. Prevent acceptance of changes until an accept icon is acknowledged.

G. Workstation Applications Editors:

1. Provide editing software for each system application at the PC workstation.
2. Edited applications shall be automatically downloaded and executed at the controller panel.
3. Programming Description: Definition of operator device characteristics, ASC's, individual points, applications and control sequences shall be performed through fill-in-the-blank templates.

4. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hard copy printouts of all configuration and application data.
5. System definition and modification procedures shall not interfere with normal system operation and control.
6. Provide consistent text-based displays of all system point and system applications.
7. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.
8. Full screen editor for each application shall allow operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 - e. Schedules.
9. Scheduling:
 - d. Allow scheduling down to the zone or room level.
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be grouped, scheduled, and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 - e. Schedule expiration.
 - d. Temporary overrides of systems with user adjustable time-out.
 - f. Provide minimum three tiers of priorities for scheduling.
 - 1) Priority 1: Event, temporary, or override.
 - 2) Priority 2: Calendar.
 - 3) Priority 3: Default.
 - g. Higher priority schedules shall overlay with lower priority schedules without interrupting or deleting them. Upon expiration of a higher priority schedule, schedule shall revert to next lower priority.
 - h. Expired priority 1 and priority 2 schedules shall be automatically deleted after execution.
10. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented programming language, allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
 - 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
 - 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
 - 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.6 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 - 1. User access secured via user passwords and user names.
 - 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 - 3. User Log On/Log Off attempts are recorded.
 - 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 - 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 - 2. Exception Schedules:
 - a. Based on any day of the year.
 - b. Defined up to one year in advance.
 - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
 - 3. Holiday or Special Schedules:
 - a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. System Coordination: Provide a standard application for equipment coordination. The application shall provide the operator with a method of grouping together equipment based on function and location. Groups shall be capable of being used for scheduling and other applications.
- E. Alarms:
 - 1. Binary object is set to alarm based on the operator specified state.
 - 2. Analog object to have high/low alarm limits.
 - 3. All alarming is capable of being automatically or manually disabled.
 - 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - 5. Reporting Action Options:
 - a. Start Programs.
 - b. Print.
 - c. Logged.
 - d. Custom messaging.
 - e. Graphical displays.
 - f. Dial out to workstation receivers via system protocol.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation on the control drawings.
- H. PID Control Characteristics:
 - 1. Provide proportional-integral algorithms.
 - 2. Direct or reverse action.

3. Anti-windup.
 4. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 5. User selectable controlled variable, set-point, and PI gains.
- I. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
 2. Order of equipment startup is user selectable.
- J. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
 2. Allows minimum on-time and off-time to be selected.
 3. Allows the number of times each piece of equipment may be cycled within any one-hour period.
- K. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- L. Trending: Building controllers shall allow collection and delivery of (time, value) pairs.
- M. Totalization:
1. Run-Time Totalization:
 - a. Totalize run-times for all binary input objects.
 - b. Provides operator with capability to assign high run-time alarm.
 - c. Generates unique, user-specified messages when the limit is reached.
 - d. Resolution: Adjustable down to one minute.
 2. Pulse Totalization:
 - a. Totalize consumption for user-selected analog and binary pulse input-type objects.
 - b. Configurable for a daily, weekly, or monthly basis.
 - c. Provide calculation and storage accumulations of up to 9,999,999 units (e.g. KWH, gallons, KBTU, tons, etc.).
 - d. Resolution: Adjustable down to one minute.
 - e. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.
 - f. The information available from the Pulse Totalization shall include, but not be limited to, the following:
 - 1) Peak Demand, with date and time stamp
 - 2) 24-hour Demand Log
 - 3) Accumulated KWH for day
 - 4) Sunday through Saturday KWH usage
 - 5) Sunday through Saturday Demand kW
 - 6) Demand kW annual history for past 12 periods
 - 7) KWH annual history for past 12 periods
 3. Event Totalization:
 - a. Count user-selected events, such as the number of times a pump or fan system is cycled on and off.
 - b. Provide storage accumulations of up to 9,999,999 events before reset.
 - c. Warning Limit: User definable. Generate unique, user-specified messages when the limit is reached.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices and wiring are installed prior to installation proceeding.
- E. Verify the integrity of control wiring, raceways, control panels, sensors, and control devices prior to reusing for the new work.
- F. Verify wiring insulation is defect free and test wiring for continuity and ground faults.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Coordination:
 1. The BAS Contractor shall execute his work in such a manner as to cause the minimum interference to the operation of the building.
 2. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
 3. Where the BAS shall share a common network backbone via a VLAN, provide temporary network access for BAS construction, startup, and commissioning. Coordinate transition of network operation to Owner's IT group.
 4. Coordinate with the Owner to display additional virtual points on individual schematic graphic screens that are not directly associated with that system. Examples may include outdoor air temperature or global alarm conditions.
- B. Web Services Enabled Network:
 5. Provide an IP network data drop for connection of BAS into Owner's IP network. Coordinate final location of IP network data drop with the Owners' IT staff.
 6. If the Owner has no preference or not indicated on the drawings, locate data drop within the main BAS control panel.
 7. Coordinate with the Owner's IT department to implement proper security measures, including secure access to the network data drop and firewalls at all virtual access points to the internet to protect access to the BAS.
- C. General Workmanship:
 1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
 2. Install all equipment in readily accessible locations.
 3. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
 4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
 8. Control wiring routed in wall cavities shall be installed in conduit.
 9. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
 10. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Controllers:
 1. Install controllers in a locked control panel. Provide common keying for all controller covers.
 2. Provide a separate controller for each piece of controlled equipment, such as an AHU, FCU, VAV box, etc. A controller may control more than one piece of equipment provided that all points

associated with the equipment are assigned to the same BAS controller. Global points used for control loop reset are exempt from this requirement.

3. Select building controllers and custom application controllers to provide the required I/O point capacity required to monitor all of the hardware points listed on the control drawings.
4. Application specific controllers may be used where factory programming is capable of executing all control functions specified in the sequences of operation. Contractor shall add supplemental controllers, devices, and programming as required to execute the specified control function if the ASC cannot.

D. Wiring:

1. All control and interlock wiring shall comply with national and local electrical codes.
5. Wire all safety devices through both hand and auto positions of motor starting device to ensure 100 percent safety shut-off.
2. Provide interlock wiring between devices as indicated on the control drawings.
3. Provide electrical wiring for relays (including power feed) for temperature and pressure indication.
4. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
5. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.
6. Conceal all low voltage wiring in finished rooms.
7. Conceal all low voltage wiring in unfinished rooms below the elevation of the lights. Low voltage wiring above the elevation of the lights may be exposed.
8. Routing of low voltage wiring above working heights in equipment rooms and above accessible ceilings is acceptable subject to following criteria:
 - a. Wiring shall be plenum rated.
 - b. Do not lay wiring on ceiling tiles.
6. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended applications.
7. All wiring in mechanical, electrical, service rooms, or where subject to mechanical damage, shall be installed in raceway at levels below 10 feet.
8. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two wires (e.g., relays and transformers).
9. Where Class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it and neatly tied at 10 foot intervals.
10. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
11. All wire-to-device and wire-to-wire connections shall be made at a terminal block or terminal strip.
12. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
13. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, coordinate with Division 26 to provide step-down transformers.
14. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
15. Install plenum wiring in sleeves where it passes through floors and walls. Maintain fire rating at all penetrations.
16. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
17. Include one pull string in each raceway 1 inch and larger.
18. Use coded conductors throughout with conductors of different colors.
19. Control and status relays shall be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

20. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (e.g., steam pipes or flues).
21. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
22. Install insulated bushing on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
23. Terminate all control and/or interlock wiring and maintain updated (as-built) wiring diagrams with terminations identified at the job site.
24. Terminate BAS sensor input wiring cable shield by taping back at the field device and connect shield to the grounded control panel chassis or sub-panel.
25. Terminate BAS comm bus cable shield between controllers per manufacturer recommendations.
26. Terminate management level/enterprise level network wiring cable shield by wrapping the drain wire around the foil shield and connecting the ground strip to the drain wire.
27. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than 1/2 inch electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.
28. Raceway shall be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations shall be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

E. Communication Wiring:

1. Adhere to the items listed in the "Wiring" article in Part 3 of this specification in addition to the requirements listed below.
2. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication wiring.
3. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
4. Do not install power wiring, in excess of 30 Vac RMS, in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, use separate twisted shielded pairs with the shields grounded in accordance with the manufacturer's wiring practice.
5. Communication conduits shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
6. Do not exceed maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer during installation.
7. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
8. When a cable enters or exits a building, install a lightning arrestor between the lines and ground. Install the lightning arrestor according to the manufacturer's instructions.
9. Ground (earth ground) all shields at one point only, to eliminate ground loops.
10. All runs of communications wiring shall be unspliced length when that length is commercially available.
11. Terminate shielded cable splices in accessible locations. Harness cables with cable ties.
12. Make all wire-to-device and wire-to-wire connections at a terminal block or terminal strip.
13. Label all communications wiring to indicate origination and destination data.
14. Ground coaxial cable in accordance with NEC regulations.
15. Install BACnet MS/TP communications wiring in accordance with ASHRAE/ANSI Standard 135
 - a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)

- b. The maximum length of an MS/TP segment shall be 4000 ft with AWG 22 or 24 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
- c. The maximum number of nodes per segment shall be 50. Additional nodes may be accommodated by the use of repeaters.
- d. An MS/TP EIA-485 network shall have no T connections.

F. Identification of Hardware and Wiring:

- 1. Label all wiring and cabling, including that within factory-fabricated panels, at each end within 2 inch of termination with the BAS address or termination number.
- 2. Permanently label or code each point of field terminal strips to show the instrument or item served.
- 3. Identify control panels with minimum 1/2 inch letters on laminated plastic nameplates.
- 4. Identify all other control components with permanent labels. Label all plug-in components such that removal of the component does not remove the label.
- 5. Identify room sensors related to terminal box or valves with nameplates.
- 6. Maintain manufacturers' nameplates and UL or CSA labels visible and legible after equipment is installed.
- 7. Identifiers shall match record documents.

3.3 STARTUP AND DEMONSTRATION

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing the BAS in permanent operation.
- B. Contractor shall provide an on-site controls technician or programmer familiar with the project BAS installation and system programming to assist the Commissioning Agent as directed during all phases of system functional testing.
- C. Coordinate with Owner the setup of logins, passwords, and security level access for individuals requiring access to the BAS.
- D. BAS shall be set up and checked by factory trained technicians skilled in the setting and adjustment of the BAS equipment used in this project. Technicians shall be experienced in the type of HVAC systems associated with this project.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- F. Test each control device to ensure that it is operating properly and is calibrated to the appropriate operating requirements. Run each control device through its range of operation and sequence. Verify all normal positions are correct. Adjust and tune PID control constants to achieve proper system operation.
 - 1. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 - 2. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - 3. Optimum start/stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - 4. Any tests that fail to demonstrate the operation of the BAS shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- G. Test and verify control interfaces to other building systems integrated into the network.

- H. Verify all alarms and interlocks.
 1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
 4. Verify fire/smoke and smoke damper functionality. Verify that they respond to the proper fire alarm system general, zone, and/or detector trips.

- I. Document on system equipment schedules the final setting of controller PID constant settings, setpoints, manual reset values, maximum and minimum controller output, and ratio and bias settings in units and terminology specific to the controller. Store documentation with operator workstation.

- J. Demonstrate complete and operating system to Owner.
 1. Prior to acceptance, the BAS shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process.
 3. The Contractor shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. Any test equipment required to provide the proper operation shall be provided by and operated by the Contractor.
 4. Demonstrate compliance with sequences of operation through all modes of operation.
 5. Demonstrate complete operation of operator interface.

- K. Acceptance:
 1. All tests described in this specification shall have been performed to the satisfaction of the Owner prior to the acceptance of the BAS as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the completion requirements if stated as such in writing by the Contractor and submitted for approval by the Owner. Such tests shall then be performed as part of the warranty.
 2. The BAS shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved.

3.4 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.

3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of eight hours on the operation and maintenance of the equipment provided under this section.
- B. Organize the training into sessions or modules for different levels of operators. Owner designated personnel shall be trained based on the level of operator training described below.
- C. Day-to-day Operator Training:
 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 2. Proficiently operate the BAS.
 3. Understand BAS architecture and configuration.
 4. Understand BAS components.

5. Understand system operation, including BAS control and optimizing routines (algorithms).
6. Operate the workstation and peripherals.
7. Log on and off the system.
8. Access graphics, point reports, and logs.
9. Adjust and change system set points, time schedules, and holiday schedules.
10. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
11. Understand BAS drawings and Operation and Maintenance manual.
12. Understand the job layout and location of control components.
13. Access data from BAS controllers and ASCs.
14. Operate portable operator's terminals.
15. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.

D. Advanced Operator Training:

1. Make and change graphics on the workstation.
2. Create, delete, and modify alarms, including annunciation and routing of these.
3. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals.
4. Create, delete, and modify reports.
5. Add, remove, and modify system's physical points.
6. Create, modify, and delete programming.
7. Add panels when required.
8. Add operator interface stations.
9. Create, delete, and modify system displays, both graphical and others.
10. Perform BAS field checkout procedures.
11. Perform BAS controller unit operation and maintenance procedures.
12. Perform workstation and peripheral operation and maintenance procedures.
13. Perform BAS diagnostic procedures.
14. Configure hardware including PC boards, switches, communication, and I/O points.
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
16. Adjust, calibrate, and replace system components.

E. System Manager/Administrator Training:

1. Maintain software and prepare backups.
2. Interface with job-specific, third-party operator software.
3. Add new users and understand password security procedures.

F. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

G. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

H. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

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SECTION 15532 (232300) - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Filter-driers.
- E. Solenoid valves.
- F. Expansion valves.

1.2 SUBMITTALS

- A. Product Data: Provide general assembly of valves and specialties, including manufacturer's catalog information. Provide manufacturer's catalog data including load capacity.
- B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment.
- C. Test reports specified in Part 3 below.
- D. Manufacturer's Installation Instructions: Indicate support requirements, connection requirements and isolation requirements for servicing.
- E. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.
- F. Maintenance Data: Include maintenance instructions for refrigerant valves and piping specialties, for inclusion in Operation and Maintenance manual.

1.3 QUALITY ASSURANCE

- A. Comply with Division 23 Section, "Basic Piping Materials and Methods."
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, and maintain sealed until connected into system.

PART 2 - PRODUCTS AND MATERIALS

2.1 REGULATORY REQUIREMENTS

- A. Comply with ASME/ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
- B. Comply with ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
- C. Comply with applicable Mechanical Code.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.2 PIPING

- A. Copper Tubing:
 - 1. ASTM B280, Type ACR, seamless, hard-drawn straight lengths and soft-annealed coils. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.
 - 2. ASTM B88, Type L, seamless, hard-drawn straight lengths and soft-annealed coils.
 - 3. ASTM B88, Type K, seamless, hard-drawn straight lengths and soft-annealed coils.
- B. Refrigerant Line Kits:
 - 1. Type ACR seamless copper roll of refrigerant tubing with pipe diameters as recommended by the manufacturer and of length as required for the installation.
 - 2. Factory or field installed flexible unicellular insulation:
 - a. Minimum thickness as required per Division 23 section "HVAC Insulation".
 - 3. Quick-connect flare tubing compression fittings or solder connections as required to match the connections of the condensing unit and evaporator coil.

2.3 FITTINGS

- A. Wrought-Copper Fittings for Solder-joint: ANSI B16.22, streamlined pattern.
- B. Mechanical Flared Fittings: ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tube.
- C. Press Fit Fittings:
 - 1. Acceptable Manufacturers:
 - a. Rapid Locking System (Zoomlock)
 - 2. Fittings shall be approved with copper tubing conforming to ASTM B280, B88 or B743.
 - 3. Fittings shall be approved with hard (drawn) and soft (annealed) copper tubing Type ACR, L and K.
 - 4. Fittings shall be rated for continuous operating temperature from -40 F to 250 F and maximum operating pressure of 700 psi.
 - 5. Fittings shall be compatible with the oils and lubricants used in the refrigerant.

2.4 JOINING MATERIALS

- A. Refer to Division 23 Section "Basic Piping Materials and Methods" for joining materials.

2.5 PIPE SUPPORTS

- A. Hanger, supports, and anchors are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing. Provide plastic galvanic isolators for copper tubing where indicated.

2.6 REFRIGERANT

- A. Refrigerant: R- 410A, as defined in ASHRAE Standard 34.

2.7 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers
 1. Emerson Electric.
 2. Henry Technologies.
 3. Parker Hannifin/Refrigeration and air Conditioning.
 4. Sporlan, Division of Parker Hannifin.
- B. Moisture/liquid Indicators: Single port type, UL listed, with forged brass body, solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; rated for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.8 FILTER DRIERS

- A. Manufacturers:
 1. Danfoss.
 2. Emerson Electric
 3. Parker Hannifin/Refrigeration and air Conditioning.
 4. Sporlan, Division of Parker Hannifin.
- B. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:
 1. Standard capacity desiccant sieves to provide micron filtration.
- C. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg. F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.
- D. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel cap screws, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets.

2.9 SOLENOID VALVES

- A. Manufacturers:
 1. Danfoss.
 2. Emerson Electric.
 3. Parker Hannifin/Refrigeration and air Conditioning.
 4. Sporlan, Division of Parker Hannifin.

- B. Valves: 250 deg. F temperature rating, 500 psig working pressure; forged brass body, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve.
- C. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

2.10 EXPANSION VALVES

- A. Manufacturers:
 1. Danfoss.
 2. Emerson Electric.
 3. Parker Hannifin/Refrigeration and air Conditioning.
 4. Sporlan, Division of Parker Hannifin.
- B. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, and an external equalizer line.
- C. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select valve to avoid being undersized at full load and excessively oversized at part load.

PART 3 - EXECUTION

3.1 PIPE APPLICATION SCHEDULE

- A. Above Grade:
 1. Type L or Type ACR tubing.
- B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.
- C. At contractor's option, use refrigerant line kits for refrigerant systems of 5 tons and smaller capacity.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.9 requirements.
- C. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- D. Do not install PVC or non-plenum rated HDPE piping in return air plenums.

3.3 PIPING INSTALLATIONS

- A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration" and the equipment manufacturer's installation requirements.
- B. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- C. Install piping for minimum number of joints using as few elbows and other fittings as possible.

- D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
- E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
- F. Insulate piping per Division 23 Section “HVAC Insulation.”
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- I. Slope refrigerant piping as follows:
 - 1. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
 - 2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- J. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- K. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

3.4 HANGERS AND SUPPORTS

- A. Comply with the requirements of Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
- B. Install the following pipe attachments:
 - 1. Adjustable band hangers for individual horizontal runs of piping 2 inch and smaller.
 - 2. Adjustable steel clevis hangers for individual horizontal runs of piping larger than 2”.
 - 3. Spring hangers to support vertical runs.
 - 4. Provide insulation saddles and protection shields as specified in Section “Hangers & Supports for HVAC Piping & Equipment”. Provide insulation inserts as specified in Section “HVAC Insulation”.

- C. Install hangers with the following minimum rod sizes and maximum spacing:

<u>NOM. PIPE SIZE</u>	<u>MAX. SPAN-FT</u>	<u>MIN. ROD SIZE – INCHES</u>
Up to 3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8
2-1/2	9	1/2
3	10	1/2
4	12	1/2
6	14	5/8

- D. Support vertical runs at each floor. Support riser piping independently of connected horizontal piping.

- E. Install a support within one foot of each change of direction.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.5 PIPE JOINT CONSTRUCTION

- A. Reference Division 23 Section, “Basic Piping Materials and Methods” for basic pipe joint construction.
- B. Press-Fit Joints: Installers of the press-fit joints shall be trained using manufacturers training tools prior to installing any press-fit joints.
 - 1. Prepare the copper tube in accordance with manufacturers instructions.
 - 2. Install fittings to minimum depth required by the fitting manufacturer.
 - 3. Crimp the fitting only using the crimping tools allowed by the manufacturer using the jaw size appropriate for the tube diameter.
 - 4. Verify the joint is properly installed using crimp gauges or manufacturer’s approved verification methods.

3.6 VALVE AND PIPING SPECIALTIES INSTALLATIONS

- A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.
- B. Install solenoid valves ahead of each expansion valve . Install solenoid valves in horizontal lines with coil at the top.
 - 1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.
- C. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
 - 1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 - 2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 - 3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 - 4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.
- D. Install flexible connectors at the inlet and discharge connection of compressors.

3.7 EQUIPMENT CONNECTIONS

- A. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow servicing and maintenance.

3.8 FIELD QUALITY CONTROL

- A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI. Provide test report summarizing the test procedures and results of the tests.
- B. Repair leaking joints using new materials, and retest for leaks.
- C. Field Test: Every refrigerant-containing part of every system that is erected on the premises, except safety devices, pressure gauges, control mechanisms, compressors, evaporators, and systems that are factory-tested, shall be tested and proved tight after complete installation and before operation. The high side and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high side and low side of the system, respectively.

- D. Testing Procedure: Tests shall be performed with dry nitrogen. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gage on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system's components.

3.9 CLEANING

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:
 1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
 2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.10 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Clean and inspect refrigerant piping systems in accordance with requirements of Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".
- C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.11 STARTUP

- A. Charge system using the following procedure:
 1. Install core in filter dryer after leak test but before evacuation.
 2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
 3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
 4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
 5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
 6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.
- C. Review data in Operating and Maintenance Manuals. Refer to Division 01 section "Closeout Procedures."
- D. Schedule training with Owner through the Architect, with at least 7 days advance notice.

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SECTION 15891 (233113) - METAL DUCTS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes:
1. Rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.
 2. Duct liner.
 3. Wire rope hanging system.
- B. Related Sections:
1. Division 7 Section "Penetrations Firestopping," for materials and methods for fire barrier penetrations.
 2. Division 7 Section "Joint Sealers," for materials and methods for sealing duct penetrations through basement and foundation walls.
 3. Division 23 Section "Identification for HVAC Piping & Equipment," for labeling and identification of metal ducts.
 4. Division 23 Section "Common Work Results for HVAC," for materials and methods for wall penetrations and equipment pads.
 5. Division 23 Section "Seismic Controls for Mechanical Systems," for seismic controls.
 6. Division 23 Section "Particulate Air Filtration" for filter requirements.

1.2 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.4 SUBMITTALS

- A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
1. Duct Liner.
 2. Sealing Materials.

3. Fire-Stopping Materials.
 4. Duct Cleaning Products.
- B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
 3. Fittings.
 4. Reinforcing details and spacing.
 5. Seam and joint construction details.
 6. Penetrations through fire-rated and other partitions.
 7. Terminal heating and cooling unit, coil, humidifier and duct silencer installations.
 8. Locations of fire and fire/smoke dampers and associated duct access doors.
 9. Locations of cleanout and access doors in grease exhaust ducts.
 10. Location of manual balancing dampers.
 11. Duct smoke detector locations. Refer to electrical drawings for general locations and coordinate locations with the electrical contractor.
 12. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:
1. Coordination with ceiling suspension members.
 2. Spatial coordination with other systems installed in the same space with the duct systems.
 3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.
- E. Duct Cleaning Plan: Submit written work plan including the following information:
1. Scope of work identifying components that will be cleaned.
 2. Identify specific environmental engineering controls required for area of work.
 3. Detail the cleaning work means and methods.
- 1.5 QUALITY ASSURANCE
- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
 2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

3. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.
 - D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Provide ductwork systems in conformance with "HVAC Duct Construction Standards – Metal and Flexible," latest edition.
 - E. Underwriter's Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.
 - F. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork systems in accordance with the standard Assessment, Cleaning and Restoration of HVAC Systems (ACR 2002).
- 1.6 PROTECTION AND REPLACEMENT
- A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.
 - B. Replace duct liner that is damaged and cannot be repaired satisfactorily, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installing new duct liner.

PART 2 - PRODUCTS AND MATERIALS

2.1 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, Coating Designation G 90. Provide mill phosphatized or galvanealed finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.
- C. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

- A. General:
 1. Comply with NFPA Standard 90A and North American Insulation Manufacturers Association (NAIMA) Standard AHC-101.
 2. Liner shall have a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84 or UL 723.
 3. Duct sizes on mechanical plans indicate clear inside airflow dimensions. Sheet metal sizes for ductwork with duct liner shall be increased accordingly to account for liner thickness.

- B. Fiberglass: ASTM C 1071, Type I or II, glass fibers firmly bonded together with a thermosetting resin with surface exposed to airstream coated to prevent erosion of glass fibers. Liner surface shall serve as a barrier against infiltration of dust and dirt, shall meet ASTM C 1338 for fungi resistance and shall be cleanable using duct cleaning methods and equipment outlined by NAIMA Duct Cleaning Guide. Duct liner shall be rated for air velocity of 6,000 fpm.
1. Rectangular fiberglass duct liner shall be Certainteed ToughGard T, JohnsManville Linacoustic RC, Knauf Atmosphere, Owens Corning QuietR or approved equal.
 - a. Thickness and Density:
 - 1) 1 inch, 1-1/2 pounds.
 2. Round fiberglass duct liner shall be Certainteed ToughGard UltraRound, JohnsManville Spiracoustic Plus, Owens Corning QuietZone Spiral, or approved equal.
 - a. Thickness and Density:
 - 1) 1 inch, 4 pound.
 3. Thermal Performance: Meet minimum "K-Factor" equal to 0.28 (Btu-in/h-sq ft-F) or better, at a mean temperature of 75°F and rated in installed condition in accordance with ASTM C518 and/or ASTM C177.
 4. Noise Reduction Coefficient (NRC): Meet the following minimum NRC in accordance with ASTM C423 Type A Mounting:
 - a. 1 Inch Thick: NRC 0.65.
 5. Liner Adhesive: Comply with NFPA Standard 90A /UL 181 classified with flame spread/smoke development less than 25/50 and ASTM C 916. Adhesive shall be a minimum 50% solid content, water-based, non-oxidizing and have a service temperature of -20 to 200 F. Water-based adhesive shall be one of the following:
 - a. Armacell LLC Armaflex 520 BLV low VOC.
 - b. Design Polymerics DP 2502.
 - c. Duro Dyne WIT.
 - d. Foster 85-60.
 - e. Childers CP-127.
 - f. Johns Manville SuperSeal HV.
 - g. Hardcast 951.
 - h. United McGill Uni-Tack.
 6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
 - a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
 - b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

2.3 SEALING MATERIALS

- A. Joint and Seam Sealants, General:
1. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
 2. Duct tape shall not be used as a sealant on any ducts.
 3. Sealants used on metal duct systems shall comply with VOC limits under VOC table classifications as "other" per SCAQMD Rule #1168.
 4. Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.
- B. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.
- C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

- D. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 70 percent solids.
 - 1. Manufacturers:
 - a. Childers CP-140.
 - b. Duro Dyne SGD.
 - c. Fosters 32-14.
 - d. Approved equal.

- E. Water-Based Joint and Seam Sealant, Non-Fibrated: UL 181 listed. Sealant shall be rated to ± 15 inches w.g. Sealant shall have a service temperature of -25 to 200 F and be freeze/thaw stable through 5 cycles.
 - 1. Manufacturers:
 - a. Childers CP-146.
 - b. Design Polymerics DP 1010.
 - c. Ductmate Proseal/Fiberseal.
 - d. Duro Dyne Duroseal.
 - e. Fosters 32-19
 - f. United Duct Sealer (Water Based).
 - g. Hardcast 601.

- F. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

- G. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum $5/8$ inch x $3/16$ inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of -25 to 180 F.
 - 1. Manufacturers:
 - a. Design Polymerics DP 1040.
 - b. Ductmate 440.
 - c. Hardcast 1104.

2.4 FIRE-STOPPING

- A. Fire-Resistant Sealant: Two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

- B. Fire-Resistant Sealant: One-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. "3M Fire Stop Foam"; 3M Corp.
 - 2. "SPECSEAL Pensil 200 Silicone Foam"; Specify Technology, Inc.
 - 3. 3M Fire Stop Sealant"; 3M Corp.
 - 4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
 - 5. "Fyre Putty"; Standard Oil Engineered Materials Co.
 - 6. "FS-ONE", Hilti, Inc.

2.5 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - 1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
 - 1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
- E. Pre-engineered roof or space lid duct supports:
 - 1. Manufacturers:
 - a. Cooper B-Line, Inc.
 - b. Elite Components.
 - c. ERICO/Caddy.
 - d. Ferguson/FNW.
 - e. Miro.
 - f. PHD Manufacturing.
 - g. PHP Systems/Design.
 - h. Roof Top Blox.
 - i. Unistrut, a brand of Atkore International Inc.
 - j. Zsi Foster.
 - 2. General: Pre-engineered devices with embedded duct support fixtures as specified.
 - 3. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
 - a. Up to 12 inch strut length support: 18 inch x 18 inch.
 - b. Up to 16 inch strut length support: 24 inch x 18 inch.
 - c. Up to 24 inch strut length support: 30 inch x 18 inch.
 - d. Thickness: Minimum 3/16 inch thick.
 - 4. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
 - a. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
 - b. Width: Nominal 4 inches.
 - 5. Attachment/Support Fixtures: As recommended by manufacturer, with straps or crossbar over top of duct to prevent movement.
 - 6. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- F. Wire Rope Hanging Systems:
 - 1. Manufacturers:
 - a. Anvil International.
 - b. Ductmate Industries, Inc; Clutcher Cable Hanging System.
 - c. Duro Dyne.
 - d. Gripple.
 - 2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
 - 3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.

4. Wire Rope: Zinc coated or galvanized steel, with wire thread type as required to support the applied working load being supported. Provide same size wire for all applications based on worst case loading.
5. Cable Lock: Cast zinc housing with steel spring with wedge grip, selected to meet the vertical load applied to the hanging system and wire thread. Do not exceed the working load limit.
6. Accessories: Hanger attachments and structural attachments shall be compatible with wire rope hanger system and shall be by the same manufacturer as the wire rope hanger system.
7. Seismic Applications: Wire rope hanger systems used for seismic supports shall be seismically tested according to ICC code guidelines EG284 with UL and SMACNA seismic approvals. Reference Division 23 Section "Seismic Controls for Mechanical Systems" for additional requirements.

2.6 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Tables 2-1 through 2-28, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
 1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
 2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 3. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.
- C. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".
- D. Field Painted Ductwork: Provide mill phosphatized finish on exposed surfaces of rectangular ductwork and duct fittings to be field painted.

2.7 RECTANGULAR DUCT FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.
- B. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
- C. Provide mitered elbows where space does not permit radius elbows, where shown on the drawings, or at the option of the contractor with the engineer's approval. The contractor shall obtain approval to substitute

mitered elbows in lieu of radius elbows prior to fitting fabrication. Mitered elbows less than 45 degrees shall not require turning vanes. Mitered elbows 45-degrees and greater shall have single thickness turning vanes of same material and gauge as ductwork, rigidly fastened with guide strips in ductwork. Vanes for mitered elbows shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork. Refer to Section "Ductwork Accessories" for turning vane construction and mounting.

- D. Provide full radius elbows for ductwork installed in noise critical spaces. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. Where space does not permit the installation of radius elbows, provide mitered elbows with sound attenuating, acoustical turning vanes. Refer to Section "Ductwork Accessories" for acoustical turning vanes.

1.1 MODULAR DUCTWORK & FITTINGS

- A. Where indicated on drawings, modular pre-manufactured straight sections of ductwork can be provided instead of fabricated ductwork. Provide sections of modular ductwork with or without taps as required to meet the ductwork layout shown on the drawings.
- B. Ductwork and fittings shall meet construction requirements of Paragraphs "Rectangular Duct Fabrication" and "Rectangular Duct Fittings" of this section
- C. Ductwork shall be lined by the modular duct manufacturer or wrapped in the field as required to meet the insulation requirements specified for the project in this section or in Section "HVAC Insulation".
- D. Approved Manufacturer:
 - 1. U.S. Engineering
3433 Roanoke Rd
Kansas City, MO 64111

2.8 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
 - 1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Fan discharge.

2. Intervals of lined duct preceding unlined duct.
 3. Upstream edges of transverse joints in ducts where duct velocity is greater than 2,500 FPM.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.9 ROUND AND FLAT OVAL DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
1. Fabricate round and flat oval ductwork of minimum 26 gauge sheet metal.
- B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-1, RL-4, or RL-5 except where diameters exceed 72 inches. Seam Types RL-2 or RL-3 may be used for ducts smaller than 72 inches in diameter if spot-welded on 1-inch intervals. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-5 through 3-13 for galvanized steel gauges. For round duct with static pressure classification of 2 inches water gauge or lower, round supply ducts may be fabricated using snaplock seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-6A, RL-6B, RL-7 or RL-8.
- C. Field Painted Ductwork: All round and flat oval ductwork and duct fittings to be field painted shall have galvanized metal primer applied in the shop after fabrication and prior to shipping.

2.10 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 3-5, 3-6 and 3-7 and with metal thickness specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Unless elbow construction type is indicated, provide elbows meeting the following requirements:
1. Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter.
 - a. Elbows in Round Duct: Provide full radius elbows.
 - b. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
 - c. Provide full radius elbows for ductwork installed in noise critical spaces or where shown on the drawings. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces.
 2. Mitered Elbows: Fabricate mitered elbows with welded construction in gauges specified below.
 - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-1.
 - b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
 - 1) 3 to 26 inches: 24 gauge.
 - 2) 27 to 36 inches: 22 gauge.

- 3) 37 to 50 inches: 20 gauge.
- 4) 52 to 60 inches: 18 gauge.
- 5) 62 to 84 inches: 16 gauge.
- c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
 - 1) 3 to 14 inches: 24 gauge.
 - 2) 15 to 26 inches: 22 gauge.
 - 3) 27 to 50 inches: 20 gauge.
 - 4) 52 to 60 inches: 18 gauge.
 - 5) 62 to 84 inches: 16 gauge.
- d. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vane.
- 3. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
- 4. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
- 5. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
- 6. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.
- 7. Round Gored Elbows Gauges: Same as for non-elbow fittings specified above.
- 8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gauge.

2.11 FACTORY-MANUFACTURED DUCTWORK

A. Manufacturers:

- 1. Hercules Industries.
- 2. Lewis & Lambert.
- 3. Lindab Safe.
- 4. Linx Industries, Inc.
- 5. Semco.
- 6. Approved equal.

B. General: At the Contractor's option, factory-manufactured ductwork can be provided instead of fabricated ductwork for round and oval ductwork. The round duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer.

C. Duct Construction

- 1. Unless otherwise noted, all duct and fittings shall be constructed from galvanized steel in accordance with SMACNA's Duct Construction Standards for +10" water gauge pressure with thickness as shown in the following tables:

Single Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct	Galvanized Fittings
3-14	28	24
15-24	26	24
26-42	24	22
42-60	22	20

2. Duct shall be calibrated to manufacturer's published dimensional tolerance standard.
3. All duct 14" diameter and larger shall be corrugated for added strength and rigidity.
4. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.
5. Ducts shall be constructed using spiral lock seam sheet metal construction.
6. Ductwork to be installed in exposed locations shall have the surface prepared in the factory for field painting.

D. Fittings:

1. All fitting ends for round duct and transitions and divided flow fittings smaller than 50" diameter that convert oval duct to round duct shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
2. All fittings shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.
3. All fitting ends from 5" to 60" diameter shall have rolled over edges for added strength and rigidity.
4. All elbows from 5" to 12" diameter shall be 2 piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.
5. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0. The radius of all 15°, 30° and 60° elbows shall be 1.0 times the elbow diameter.
6. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.
7. All volume dampers shall be Lindab Safe type DRU, DSU or DTU or approved equal. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:
 - a. Locking quadrant with blade position indicator.
 - b. 2" sheet metal insulation stand-off.
 - c. Integral shaft/blade assembly.
 - d. Shaft mounted, load bearing bushings.
 - e. Gasketed shaft penetrations to minimize leakage.

2.12 SNAP-LOCK DUCT SYSTEM

- A. General: At Contractor's option, snap-lock round ductwork can be provided instead of fabricated ductwork for round ductwork up to 14" in diameter in air systems with pressures between negative 1" and positive 2" w.c..
- B. Duct Construction:
 1. Material:
 - a. Galvanized steel conforming to ASTM A653 and A924 with G-60 galvanized coating conforming to ASTM A653 and ASTM A90.
 2. Duct shall be minimum 26 gauge. Duct shall be self-locking and incorporate a factory applied gasket in the longitudinal seam and the female end of the traverse joint to provide a system that meets SMACNA Seal Class A.
 3. Fittings: Minimum 26 gauge. All high-efficiency take-offs, conicals, and collars shall have a factory applied gasket along all rivets, co-latches, and flanges. Dampered fittings shall have low leakage hardware with closed-end bearings.
- C. Gaskets: Butyl and EPDM rubber that meets flame spread index of 25 and smoke spread index of 50 according to ASTM E84.

- D. Manufacturers:
 - 1. Ductmate GreenSeam.
 - 2. Approved equal.

PART 3 - EXECUTION

3.1 DUCT MATERIAL APPLICATION

- A. All ducts shall be galvanized steel.
 - 1. Exterior Ductwork: Ductwork installed exterior to the building shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".

3.2 DUCT LINER INSTALLATION

- A. Fiberglass Duct Liner:
 - 1. Attach fiberglass duct liner using fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
- B. Application: Provide duct liner on the following interior air ducts and where specified on the drawings.
 - 1. Supply Ductwork:
 - a. Exposed rectangular ductwork.
 - b. Exposed round ductwork.
 - c. First 15 feet of ductwork downstream of equipment outlets.
 - 2. Return Ductwork:
 - a. Exposed rectangular ductwork except for return air from units serving drop boxes.
 - b. Exposed round ductwork.
 - c. First 15 feet of ductwork upstream of equipment outlets.

3.3 DUCT INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Duct System Pressure Class: Construct and install each duct system except factory-manufactured ductwork for the specific duct pressure classification indicated. For factory-manufactured ductwork, refer to Paragraph "Factory-Manufactured Ductwork".
 - 1. Supply Air Ducts: 3 inches water gauge.
 - 2. Primary Supply Air Ducts (upstream of terminal boxes): 4 inches water gauge.
 - 3. Secondary Supply Air Ducts (downstream of terminal boxes): 2 inches water gauge
 - 4. Return and Outdoor Air Ducts: 2 inches water gauge, negative pressure.
 - 5. Exhaust Air Ducts: 2 inches water gauge, negative pressure.
- C. Install ducts with the fewest possible joints.
- D. Seal duct joints with the appropriate sealing material.
- E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

- G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.
- J. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- K. Install insulated ducts with 1-inch clearance outside of insulation.
- L. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- M. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- N. Exposed Ductwork: Exposed ductwork shall be free of defects, dents or blemished surfaces to provide a smooth, finished appearance. Any damaged material shall be replaced with new material. Ductwork that is to be field painted shall have surfaces wiped clean of lubricant, dirt, or fil prior to priming and painting. Apply primer and paint of type as recommended by paint manufacturer for duct material and finish.
- O. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- P. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.
- Q. Acoustical Barrier Penetrations: Where a duct passes through a wall, ceiling or floor slab of a noise critical space, provide a clear annular space of 1-inch between the duct and the structure. Refer to Section "Common Work Results for HVAC" for noise critical spaces. The Contractor shall check the clearance and, if clearance is acceptable, shall install the duct and pack the voids full depth with mineral fiber batt insulation. Contractor shall caulk both ends with a non-aging, non-hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material. Where there is insufficient clearance space, Contractor shall place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.

3.4 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints as follows:
 1. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
 2. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized.
- B. Seal externally insulated ducts prior to insulation installation.

- C. Ductwork installed exterior to the building shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.

3.5 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in Chapter 5 of the SMACNA "HVAC Duct Construction Standards", 2005 Edition.
- B. Installation of Wire Roper Hanger Systems:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer's recommended load rating.
 - 3. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.
- C. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- D. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- E. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.
- F. Install concrete insert prior to placing concrete.
- G. Install powder actuated concrete fasteners after concrete is placed and completely cured.
- H. Installation of Pre-Engineered Roof Duct or space lid Supports:
 - 1. Install pre-engineered roof duct supports to rest on the roofing membrane or space lid without attachment to the roof structure or penetration through the roofing assembly.
 - 2. Install pre-engineered roof duct supports anchored to the roof structure.
 - a. Install supports to meet the specified design criteria.
 - 1) Building Design Risk Category: [II][III or IV].
 - 2) Design Wind Speed: [XXX] mph.
 - b. Coordinate with the pre-engineered roof duct support manufacturer to anchor the duct supports directly to the roof structure in accordance with the manufacturer's installation instructions or provide intermediate duct supports engineered to meet the design criteria.
 - c. Submit design and installation requirements as a Deferred Submittal.
 - d. Pre-Engineered Duct Support Rails: Provide rigid backing material (e.g., insulation, wood, etc.) to maintain cant slope. Install supports to maintain continuous insulation on roof.
 - 3. Refer to Section "Seismic Controls for Mechanical" for seismic bracing requirements.

3.6 PENETRATIONS

- A. Fire Barrier Penetrations: Where ducts pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity.
- B. Exterior Wall Penetrations: Seal duct penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 23 Section "Basic Piping Materials and Methods" for additional information.

- C. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Seal ducts that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 23 Section "Basic Piping Materials and Methods" for special sealers and materials.

3.7 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 4-5 and 4-6.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 7-6 and 7-7. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."
- D. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 7-8.

3.8 FIELD QUALITY CONTROL

- A. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.
- B. If permanent HVAC equipment is used during the construction period, provide temporary filters at all openings in the ductwork and at inside equipment to protect the system from dust, dirt, paint, and moisture. Replace and maintain filters when needed, but not less than every month. On the day of substantial completion, clean the duct system and provide a new set of filters in the HVAC unit.
 - 1. Refer to Division 23 Section 234100 Particulate Air Filtration for filter requirements.

3.9 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING FOR HVAC" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum duct systems prior to final acceptance to remove dust and debris.

3.10 CLEANING NEW SYSTEMS

- A. Contractor shall clean the HVAC systems in accordance with NADCA.
- B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- C. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.
 - a. Do not degrade structural, thermal or functional system integrity of the duct.

- b. Provide access doors complying with UL 181 to cover new openings. Refer to Division 23 Section "Air Duct Accessories".
 - c. Seal openings with tape and sealant complying with UL 181A.
 - 2. Disconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
 - D. Vent vacuuming system to the outside. Provide filtration and/or containment systems to keep debris removed from HVAC systems from contaminating other spaces. Locate exhaust down wind and away from air intakes and other points of entry into building.
 - E. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.
 - F. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet.
 - 5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.
 - H. Cleanliness Verification:
 - 1. Visually inspect metal ducts for contaminants.
 - 2. Where contaminants are discovered, re-clean and re-inspect ducts.
- 3.11 CLEANING EXISTING SYSTEMS
- A. Contractor shall clean the HVAC systems in accordance with NADCA.
 - B. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Use existing service openings where possible.
 - 2. Create other openings to comply with duct standards.
 - a. Do not degrade structural, thermal or functional system integrity of the duct.
 - b. Provide access doors complying with UL 181 to cover new openings. Refer to Division 23 Section "Air Duct Accessories".
 - c. Seal openings with tape and sealant complying with UL 181A.
 - 3. Disconnect flexible ducts as needed for cleaning and inspection.

4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
 5. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.
- D. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
 2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.
- E. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- F. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide operative drainage system for wash down procedures.
 7. Biocidal Agents and Coatings: Apply biocidal agents, Design Polymer DP 2545, Foster 40-20 or approved equal, if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.
- G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.
- H. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
 2. Visually inspect metal ducts for contaminants.
 3. Where contaminants are discovered, re-clean and re-inspect ducts.
- I. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
 2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.
- J. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION

SECTION 15892 (233117) - FABRIC DUCTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK:

- A. Extent of fabric ductwork is indicated on drawings and by requirements of this section.
- B. Types of fabric ductwork required for project include the following:
 - 1. Fabric Air Dispersion Products.

1.2 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Product must be classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A.
 - 2. Product must have an acceptable evaluation report from ICBO-ES.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- B. Performance Data: Submit performance data for products specified in this section including airflow, static pressure, throw and sound data of diffusers.
- C. Color Samples: Submit color samples for selection of final color by Architect.
- D. Submit manufacturer's installation and maintenance instructions on materials and manufactured products for work of this section.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Protect fabric air dispersion systems from damage during shipping, storage and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURER:

- A. Subject to compliance with requirements, provide products manufactured in the United States, from one of the following:
 - 1. DuctSox
 - 2. FabricAir, Inc.

3. KE Fibertec
4. NanoSox
5. Q-Sox.

2.2 TEXTILE AIR DISPERSION SYSTEM:

- A. Air diffusers shall be constructed with both internal retention and external tensioning.
1. System shall consist of internal tensioning baskets with cable or track stops that externally tension the system off of the suspension system selected below along with 360 degree internal retention hoops that are spaced 5' on center between tensioning baskets.
 2. Tensioning baskets are designed to self-lock when tension is applied to the system.
 3. All straight sections utilize both internal retention hoops and external tensioning with the use of the tension baskets, all fittings (crosses, elbows, reducers, and tees) utilize internal retention hoops.
 4. Distance between consecutive tensioning baskets should not be more than 40'.
 5. System shall be installed with a one row suspension system located 1.5" above top-dead-center of the textile system.
 6. System attachment to cable or U-Track shall be made using Gliders spaced no further than 12 inches apart.
 7. One row suspension options (must specify if multiple on same project)
 - a. Cable suspension hardware to include cable, eye bolts, thimbles, cable clamps, and turnbuckle(s) as required.
 - 1) Galvanized steel cable suspension options
- B. TEXTILE
1. Textile Construction: Woven polyester with non-permeable coating, fire retardant in accordance with UL 2518.
 2. Weight: 5.5 oz./yd² per ASTM D3776
 3. Air Permeability: 0 CFM/ft² per ASTM D737, Frazier
 4. Warranty: 10 years
- C. TEXTILE SYSTEM FABRICATION REQUIREMENTS:
1. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips (inlets, endcaps, and mid-sections) and top access zippers for tension lock attachments.
 2. Integrated air dispersion shall be specified and approved by manufacturer. (select only those that apply)
 - a. Orifices
 - 1) Air dispersion and extended throws are accomplished by orifices. Dispersion orifice sizing, up to 5 inch diameter (design dependent).
 - 2) Diameter, quantity, and location of orifices to be specified and approved by manufacturer.
 3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. zip screw fastener – supplied by contractor.
 4. Inlet connection includes zipper for easy removal / maintenance.
 5. Lengths to include required intermediate zippers as specified by manufacturer.
 6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
 7. End cap includes zipper for easy maintenance.
 8. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.
- D. DESIGN PARAMETERS:
1. Textile air diffusers shall be designed from 0.25" water gage minimum to 3.1" maximum, with 0.5" as the standard.

2. Textile air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F.
3. System overall design; diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.
4. Use textile air dispersion systems only for positive pressure air distribution components of the mechanical ventilation system.

PART 3 - EXECUTION

3.1 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM:

- A. Install fabric air dispersion system including support system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to the fabric duct system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If the fabric duct system becomes soiled during the installation, remove and clean the fabric duct system following the manufacturer's instructions.

END OF SECTION

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SECTION 15910 (233300) - AIR DUCT ACCESSORIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this Section.
- B. Types of ductwork accessories required for project include the following:
 - 1. Dampers.
 - a. Low pressure manual dampers.
 - b. Counterbalanced backdraft dampers.
 - 2. Cable operated damper systems.
 - 3. Smoke Detectors
 - 4. Turning vanes.
 - 5. Duct hardware.
 - 6. Duct access doors.
 - 7. Flexible ductwork.
 - 8. Flexible elbow assembly.
 - 9. Metal duct connectors.
 - 10. Flexible duct connectors.
- C. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not work of this Section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
 - 1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 2005 Edition.
 - 2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
 - 3. UL Compliance:
 - a. Construct, test, and label fire dampers in accordance with current edition of UL Standard 555 "Fire Dampers". Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S "Smoke Dampers".
 - b. Construct flexible ductwork in compliance with UL Standard 181 "Factory-Made Air Ducts and Connections".
 - c. Duct tape shall be labeled in accordance with UL Standard 181B and marked 181B-FX.
 - d. Duct clamps shall be labeled in accordance with UL Standard 181B and marked 181B-C.
 - e. Grease exhaust duct wrap shall meet the fire protection requirements defined by UL Standard 1479 "Fire Tests of Through-Penetration Firestops."
 - f. Fire rated duct wrap shall meet the fire protection requirements defined by UL Standard 1479 "Fire Tests of Through-Penetration Firestops."
 - 4. NFPA Compliance:
 - a. Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories. Comply with NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems."

- b. Comply with NFPA 96 “Ventilation Control and Fire Protection of Commercial Cooking Operations” for fire-rated grease exhaust ducts.
- 5. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 “Surface Burning Characteristics” (NFPA 255) method.
 - a. Duct silencers shall be tested for performance in accordance with ASTM E477 “Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.”
 - b. Grease exhaust duct wrap shall be tested for performance in accordance with ASTM E 2336 “Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems” and ASTM E814 “Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops”.
 - c. Fire rated duct wrap shall be tested in accordance with ASTM E814 “Standard Test Methods of Fire Resistance of Through-Penetration Fire Stops”.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory including dimensions, capacities and materials of construction; and installation instructions. Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.4 SPARE PARTS

- A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

PART 2 - PRODUCTS AND MATERIALS

2.1 DAMPERS

- A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".
 - 1. Material: Galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.
 - 2. Construction: Bearings shall be corrosion resistant, molded synthetic and axles shall positively lock into the damper blade. Extended shafts and standoff bracket for insulation clearance shall be metal material. Provide with locking quadrant.
 - 3. Blade Seals: Where dampers are used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.
 - 4. Dampers shall be Greenheck Model MBD Series, or approved equal.
- B. Control Dampers: Refer to Division 23 section Instrumentation and Control Devices for HVAC for control dampers; not work of this section.
- C. Counterbalanced Backdraft Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to open at indicated static pressure. Construct frames and blades of minimum 16-ga aluminum. Provide minimum 1/2" diameter, corrosion-resistant bearings and 1/2" diameter, galvanized or stainless steel axles.

Blade edge seals shall be mechanically locked into blade edge. Blade seals shall be neoprene for round dampers. Blade seals shall be silicone or vinyl for rectangular dampers.

D. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.
2. Arrow United Industries.
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Ruskin Mfg. Co.
9. TAMCO
10. Vent Products

2.2 CABLE OPERATED DAMPER SYSTEMS

A. General: Where access to dampers through a hard ceiling is required, provide a concealed, cable operated volume damper with remote operator.

1. Damper shall be adjustable through the diffuser face or frame with standard 1/4" nutdriver or flat screwdriver.
2. Cable assembly shall attach to damper as one piece with no linkage adjustment.
3. Positive, direct, two-way damper control shall be provided with no sleeves, springs or screw adjustments to come loose after installation.
4. Provide cable length as required to span the distance from the damper to the remote operator location.
5. Support cable assembly to avoid bends and kinks in cable.

B. Where approved by Architect, a ceiling cup with cover plate can be used for access to cable operator.

C. Manufacturer: Subject to compliance with requirements, provide cable operated damper systems of one of the following:

1. Metropolitan Air Technology, Inc. (Reference model is RT-250 for round ducts, RT-200 for rectangular ducts, with RT-WGA operator).
2. Young Regulator Co. (Reference model is 5020-1200 for round ducts, 820-1200 for rectangular ducts, with RT-270-275 operator).

2.3 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes and runners fabricated from galvanized sheet metal, lock-forming quality, ASTM A 653, minimum Coating Designation G 60, of the same gauge thickness or greater as the ductwork in which they are installed. Vanes shall be rigidly fastened with guide strips to minimize noise and vibration. Vanes in ductwork over 30" deep shall be installed in multiple sections with vanes not over 30" long and shall be rigidly fastened. Turning vanes shall be constructed per SMACNA Duct Construction Standards Metal and Flexible – 2005 Edition, Figure 4-3 and set into side strips suitable for mounting in ductwork.

B. Acoustical Turning Vanes: Provide acoustical turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill in systems serving noise critical spaces. Refer to Section "Common Work Results for HVAC".

C. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

1. Aero Dyne Co.
2. Anemostat Products Div.; Dynamics Corp. of America.

3. Ductmate Industries.
4. Duro Dyne Corp.
5. Elgen Manufacturing Co., Inc.
6. Hart & Cooley Mfg. Co.
7. Register & Grille Mfg. Co., Inc.
8. Sheet Metal Connectors, Inc.

2.4 DUCT HARDWARE

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
 1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
 2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
 1. Ductmate Industries.
 2. Elgen Manufacturing Co., Inc.
 3. Ventfabrics, Inc.
 4. Young Regulator Co.

2.5 DUCT ACCESS DOORS

- A. General: Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10" by 10" and maximum size of 24" by 24". Provide removable section of duct where duct size is too small for a 10" by 10" access door. Construct access doors in accordance with SMACNA "HVAC Duct Construction Standards – Metal and Flexible" and as specified herein. Label access doors for fire and smoke dampers as specified in Paragraph "Installation of Ductwork Accessories.
- B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.
- C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
 1. Air Balance Inc.
 2. Ductmate Industries.
 3. Duro Dyne Corp.
 4. Greenheck.
 5. Register & Grille Mfg. Co., Inc.
 6. Ruskin Mfg. Co.
 7. Ventifabrics, Inc.
 8. Vent Products.
 9. Zurn Industries, Inc.; Air Systems Div.

2.6 FLEXIBLE DUCT.

- A. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regards to required quality of construction and materials. Flexible duct shall have fire retardant polyethylene or reinforced metalized protective vapor barrier as follows:

1. Low pressure (duct pressure class up to and including 2" w.g.) and medium pressure (duct pressure class greater than 2" up to and including 6" w.g.)
 - a. Fire retardant polyethylene vapor barrier
 - 1) Flexmaster Type 5B
 - 2) JPL Type PR Series
 - 3) Thermaflex Type G-KM
 - b. Reinforced metalized vapor barrier
 - 1) ATCO 30 Series
 - 2) Flexmaster Type 5M
 - 3) JPL Type MHP Series
 - 4) Thermaflex Type M-KE
 2. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
 3. Provide acoustical, fiberglass insulated duct with minimum R-value of R-6.0.
- B. Manufacturer: Subject to compliance with requirements, provide flexible ductwork of one of the following:
1. ATCO Rubber Products.
 2. Flexmaster.
 3. JPL (J.P. Lamborn Co)
 4. Thermaflex.

2.7 FLEXIBLE ELBOW ASSEMBLY

- A. General: At Contractors option, in lieu of rigid sheet metal elbows at connections to air inlets and outlets in concealed spaces, provide flexible elbow assembly to air devices requiring a 90 degree elbow connection.
- B. Flexible elbow assembly shall be constructed of durable composite material and UL listed for use in return air plenums with a turning radius of not less than 3 inches.
- C. Flexible elbow assembly shall be FlexFlow Elbow as manufactured by Flexible Technologies, Inc., FlexRight Elbow as manufactured by Build Right Products or approved equal.

2.8 METAL DUCT CONNECTORS

- A. Description: Factory-fabricated, slide-on transverse flange connectors, corners, cleats, gaskets, and components. Material, gauge, and shape shall match the connecting ductwork.
- B. Manufacturers: Subject to compliance with requirements, provide duct connectors by one of the following or approved equal:
 1. Ductmate Industries.
 2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.9 FLEXIBLE DUCT CONNECTORS

- A. Fabric Material: Flame-retardant or noncombustible fabrics compliant with NFPA 701.
 1. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of minimum 24 gauge galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
 2. Indoor System, Flexible Connector Fabric: Glass fabric coated with neoprene.
 - a. Minimum Weight: 26 oz./sq. yd.
 - b. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - c. Service Temperature: Minus 40 to plus 200 deg F.
 3. Outdoor System, Flexible Connector Fabric: Glass fabric coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - a. Minimum Weight: 24 oz./sq. yd.

- b. Minimum Tensile Strength: 225 lbf/inch in the warp and 300 lbf/inch in the filling.
 - c. Service Temperature: Minus 40 to plus 250 deg F.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Flexible connectors shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
- D. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
 - 1. Ductmate Industries.
 - 2. Duro Dyne Corp.
 - 3. Elgen Manufacturing Co., Inc.
 - 4. Ventfabrics, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install backdraftdampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- C. Provide balancing dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper and locking quadrant for branch duct connections and take-offs to individual diffusers, registers and grilles.
- D. Coordinate all smoke and fire/smoke damper installation, wiring, and checkout to ensure that the dampers function properly and that they respond to the proper fire alarm system signal.
- E. Install ceiling radiation dampers per manufacturer's instructions. Support damper assembly from structure.
- F. Duct Smoke Detectors: Comply with NFPA 72, and NFPA 90A where adopted by the local AHJ. Install sampling tubes so they extend the full width of the duct. Tubes more than 36 inches long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke detector housing during construction. Install detector only during system testing and prior to system turnover.
 - 2. Air handling units with smoke detection that serve fan-powered terminal units:
 - a. Provide duct detection and shutdown fan-powered terminal units that are less than 2,000 cfm when the respective air handling unit shuts down.
 - b. Provide individual duct detection and shutdown for each fan-powered terminal unit exceeding 2,000 cfm.
 - 3. Provide duct detection and shutdown for air distribution systems exceeding 2,000 cfm.

- G. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Vanes shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork.
- H. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, and equipment at the following locations: Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
 - 1. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 2. Upstream from turning vanes.
 - 3. Upstream or downstream from duct silencers.
- I. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1" lettering) indicating which damper type is served. Door should be capable of being fully opened or provide removable door.

DUCT ACCESS DOOR SCHEDULE

Duct Width/Depth	Door Size	Quantity
10" TO 12"	10 X 10	1
14" TO 18"	12 X 12	1
20" TO 36"	14 X 14	1
38" TO 54"	18 X 18	1
56" TO 72"	18 X 18	2 (1 EACH END)
74" TO 96"	20 X 20	2 (1 EACH END)

- J. Install flexible duct in accordance with manufacturer's instructions. At a minimum, install two wraps of duct tape around the inner core connection and a metallic or non-metallic clamp over the tape and two wraps of duct tape or a clamp over the outer jacket.
 - 1. Flexible duct runs shall not exceed 5 feet in length. Utilize the minimum length of duct to make the connections.
 - 2. Flexible ductwork shall be installed straight as possible avoiding tight turns with a maximum of one 90 degree bend in any length. Install flexible duct fully extended minimizing compression.
 - 3. Provide continuous length with no intermediate joints.
 - 4. Support flexible duct from structure and not from ceiling tile, light fixtures or air terminals. Support for maximum sag of 1/2-inch per foot.
 - 5. Avoid incidental contact with metal fixtures, water lines, pipes, or conduit.
 - 6. Support straps/saddles shall be minimum 1-1/4" wide. Use of wire hanging systems shall utilize strap and connect wire to strap.
 - a. Factory installed suspension systems are acceptable
 - 7. Ductwork shall not be crimped against joist or truss members, pipes, conduits, etc.
 - 8. The bend radius at the center line shall be equal to or greater than one duct diameter.
 - a. Support bends approximately one duct diameter on both sides of bends.
 - 9. Connections to ductwork and air devices shall have at least 1" overlap.
- K. Provide rigid duct elbow or flexible elbow assembly where a 90 degree elbow is required at connection to air devices.
- L. Provide flexible duct connections wherever ductwork connects to vibrating equipment and when transitioning between two different metallic duct materials (e.g., aluminum to galvanized steel). Construct flexible connections of fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

- M. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 15865 (233413) - AXIAL HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Circulation fans.
- B. High Volume Low Speed (HVLS) fans.

1.2 REFERENCE STANDARDS

- A. AMCA 99 – Standards Handbook.
- B. AMCA 204 – Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- D. AMCA 230 – Laboratory Methods of Testing Air Circulation Fans for Rating and Certification.
- E. AMCA 300 – Reverberant Room method for Sound Testing of Fans.
- F. AMCA 301 – Certified Ratings Program Product Rating manual for Fan Sound Performance.
- G. AMCA 311 – Certified Ratings Program Product Rating Manual for Fan Sound Performance.
- H. UL 705 – Power Ventilators; Current Edition Including all Revisions.
- I. UL 762 – Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition Including all Revisions.

1.3 SUBMITTALS

- A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
 - 1. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
 - 2. Materials gages and finishes, including color charts.
 - 3. Dampers, including housings, linkages, and operators.
- C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement and spare parts list.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fan Belts: One set for each individual fan.

1.4 QUALITY ASSURANCE

A. AMCA Compliance:

1. Provide HVLS fans that are tested and labeled in accordance with AMCA 230.
2. Testing Requirements: The following factory tests are required for propeller, tubeaxial, mixed flow and vaneaxial fans:
 - a. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
 - b. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.6 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 - PRODUCTS AND MATERIALS

2.1 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.5.

D. Belts: Oil-resistant, non-sparking, and non-static.

E. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.

- F. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 - 1. Belt Guards: Provide OSHA compliant steel belt guards for motors mounted on the outside of the fan cabinet.
- G. Hazardous Duty: Provide fans with spark resistant construction and explosion proof motor where specified in the schedule.

2.2 CIRCULATION FANS

- A. Manufacturers:
 - 1. Big Ass Fans.
 - 2. Greenheck
 - 3. Leading Edge Fans
- B. Minka-Air General Description: Propeller-type fans less than 6 feet in diameter consisting of fan blades, hub, mounting system, motor, and fan controller.
- C. Fan Blades: Aluminum alloy or custom material as scheduled on the drawings.
- D. Hub: Cast aluminum alloy.
- E. Motor and Frame: High efficiency, brushless DC or EC motor with digital inverter drive.
- F. Mounting System: Designed for secure mounting of fan from overhead support structure.

2.3 HVLS FANS

- A. Manufacturers:
 - 1. Big Ass Fans.
 - 2. Entrematic.
 - 3. Kelley Company
 - 4. Macro Air Technology
- B. General Description: Propeller-type fans 6 feet in diameter and larger consisting of fan blades, hub, mounting system, bevel gear reducer drive, motor, and fan controller.
 - 1. Acceptable alternate to bevel gear reducer drive, motor and VFD as specified herein is a gearless, direct drive fan to motor connection and radial flux, permanent magnet AC motor as furnished by MacroAir.
- C. Fan Blades: Aluminum alloy, airfoil design.
- D. Hub: Cast aluminum alloy incorporating 1/4" or greater steel safety clips to restrain the hub/airfoil assembly in case of shaft failure.
- E. Bevel Gear Reducer: High efficiency, helical gear reducer with a cast iron housing, designed for low noise and long service life with a backlash of less than 20 arc-minutes. Output shaft shall be stainless steel. Gear reducer shall be permanently lubricated and be assembled with double lip seals to prevent contamination or oil leakage.
- F. Motor and Frame: 1750 RPM, 208-230/460 VAC, 60 Hz, 3 phase, inverter rated with class F insulation, 40 degrees C Ambient-Continuous. Provide HP as scheduled or as applicable. Motor frame and mount shall be constructed of minimum 3/16" powder-coated steel.

- G. Mounting System: Designed for secure mounting of fan from overhead support structure with extension rod. Mount shall be constructed of minimum 3/16" powder-coated steel. Provide minimum 1/4" 7x19 steel safety cable to secure fan assembly to structure.
- H. Fan Controller:
 - 1. Auxiliary contacts to shutdown fan upon notification from fire alarm system.
 - 2. Industrial Control Panel constructed per UL 508A and NEC.
 - 3. Factory programmed Variable Frequency Drive (VFD) for soft start and infinite speed control.
 - 4. Size VFD for motor full load amp rating.
 - 5. Provide overload relay for each motor when VFD controls multiple fans.
 - 6. Provide load reactors for 460 VAC multi-fan control.
 - 7. Provide fan on/off/auto switch, speed control potentiometer, safety disconnect and properly sized fuse block.
 - 8. Provide NEMA Type 1 controls enclosure.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.

3.2 INSTALLATION

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
- B. Support units using the vibration control devices indicated and specified in Division 23 Section "Vibration Isolation for HVAC Piping and Equipment."
- C. Arrange installation to provide access space around fans for service and maintenance.
- D. Install extension rod to maintain minimum 3 feet vertical clearance between HVLS fan blades and sprinkler deflectors according to NFPA 13.

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.4 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - 1. Remove shipping blocking and bracing.
 - 2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.

7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.5 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION

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SECTION 15860 (233416) - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Centrifugal fans for indoor installations

1.2 REFERENCE STANDARDS

- A. AMCA 99 – Standards Handbook.
- B. AMCA 204 – Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- D. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.
- E. AMCA 301 – Certified Ratings Program Product Rating manual for Fan Sound Performance.
- F. UL 705 – Power Ventilators; Current Edition Including all Revisions.

1.3 SUBMITTALS

- A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
 - 1. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
 - 2. Materials gages and finishes, including color charts.
 - 3. Dampers, including housings, linkages, and operators.
- C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement and spare parts list.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fan Belts: One set for each individual fan.

1.4 QUALITY ASSURANCE

- A. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- B. UL Compliance: Fans and components shall be UL listed and labeled.
- C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- F. UL 705 – Standard for Power Ventilators, Underwriter’s Laboratory, most current edition.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.6 FIELD CONDITIONS

- A. Permanent fans may not be used for ventilation during construction.

PART 2 - PRODUCTS AND MATERIALS

2.1 FANS, GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.
- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
 - 1. Fan Shaft: Turned, ground, and polished steel, designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- C. Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210.
- D. Sound Ratings: Comply with AMCA 301. Test fans in accordance with AMCA Standard 300.
- E. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor: 1.4.
- F. Belts: Oil-resistant, nonsparking, and nonstatic.
- G. Motors: Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.

- H. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 - 1. Belt Guards: Provide OSHA compliant steel belt guards for motors mounted on the outside of the fan cabinet.
- I. Hazardous Duty: Provide fans with spark resistant construction and explosion proof motor where specified in the schedule.
- J. Factory Finish: The following finishes are required:
 - 1. Sheet Metal Parts: Prime coating prior to final assembly.
 - 2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.2 CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Acme Engrg. & Mfg. Corp.
 - 2. Bayley Fan Group.
 - 3. Chicago Blower Corp.
 - 4. Cook (Loren) Co.
 - 5. Greenheck Fan Corp.
 - 6. Hartzell Fan, Inc.
 - 7. PennBarry.
 - 8. RuppAir Management Systems
 - 9. Trane Co.
 - 10. Twin City Fan Company
- B. General Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings:
 - 1. Fabricate from formed and reinforced galvanized steel panels to form curved scroll housings, spot welded for AMCA 99 class I and II fans and continuously welded for AMCA Class III fans.
 - 2. Factory finish before assembly to manufacturer's standard. For fans handling air downstream of humidifiers, provide two additional coats of paint. Prime coating on aluminum parts is not required.
 - 3. Inlet Cones: Spun metal.
 - 4. Duct Connections: Flanged.
 - 5. Panel Bracing: Steel angle-or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
- D. Fan Wheels: Single-width single-inlet and/or double-width double-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft. Provide inlet flange and back plate for rigid attachment of blades.
 - 1. Blade Materials: Steel or aluminum.
 - 2. Blade Type: Backward-curved, flat-plate or airfoil type; forward-curved, airfoil type or radial.
- E. Bearings and Drives
 - 1. Bearings: Provide type indicated, having a median life "Rating Life" ABMA L(50) of 400,000, calculated in accordance with ABMA Standard 9 for ball bearings and ABMA Standard 11 for roller bearings
 - a. Prelubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - b. Grease-lubricated, self-aligning, pillow-block type; tapered roller bearings with double-locking collars and two-piece, cast-iron housing. Provide Zerk fittings for lubrication.

- c. Grease-lubricated, self-aligning, pillow-block type, with double spherical roller bearings with adapter mount and two-piece cast-iron housing. Provide Zerk fittings for lubrication.
 - 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard.
 - 3. Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under, selected so required rpm is obtained with sheaves set at mid-range. Fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
 - 4. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 5. Direct Drive: Provide support stand and enclosure for direct connection of motor to fan wheel.
- F. Accessories: Provide the following accessories:
- 1. Discharge Dampers: Opposed blade heavy duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.
 - 2. Inlet/Outlet Screens: Heavy wire mesh screens, mounted inside of shaft bearings for fan openings without duct connections.
 - 3. Access Doors: Latch-type handles; flush-mounted for uninsulated housings and raised-mounted for insulated housings.
 - 4. Drain Connections: Threaded, 3/4-inch NPS, capped nipple installed at lowest point of housing.
 - 5. Shaft Cooler: Metal disc between bearings and fan wheel, designed to dissipate heat from shaft.
 - 6. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
 - 7. Shaft Seals: Air-tight seals installed around shaft on drive side of single-width fans.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.
- B. Coordinate the size and location of structural steel support members.

3.2 INSTALLATION

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
- B. Support units using the vibration control devices indicated and specified in Division 23 Section "Vibration Isolation for HVAC ."
- C. Arrange installation to provide access space around fans for service and maintenance.

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.4 STARTUP

- A. Final checks before start-up: Perform the following operations and checks before start-up:
 - 1. Remove shipping, blocking, and bracing.
 - 2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
 - 7. Disable automatic temperature control operators.

- B. Starting procedures for fans:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.5 DEMONSTRATION

- A. Demonstration Services: Train Owner's maintenance personnel on the following:
 - 1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
 - 2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

- B. Schedule training with at least 7 days' advance notice.

END OF SECTION

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SECTION 15870 (233423) - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof ventilators.
- B. Cabinet exhaust fans.
- C. Upblast roof exhausters.
- D. Inline centrifugal fans.

1.2 REFERENCE STANDARDS

- A. AMCA 99 – Standards Handbook.
- B. AMCA 204 – Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- D. AMCA 300 – Reverberant Room method for Sound Testing of Fans.
- E. AMCA 301 – Certified Ratings Program Product Rating manual for Fan Sound Performance.
- F. AMCA 311 – Certified Ratings Program Product Rating Manual for Fan Sound Performance.
- G. NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- H. UL 705 – Power Ventilators; Current Edition Including all Revisions.
- I. UL 762 – Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition Including all Revisions.

1.3 SUBMITTALS

- A. General: Submit data in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements. Include the following:
 - 1. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
 - 2. Materials gages and finishes, including color charts.
 - 3. Dampers, including housings, linkages, and operators.

- C. Shop Drawings: Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- D. Wiring Diagrams: Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
- E. Maintenance Data: Include instructions for lubrication, motor and drive replacement and spare parts list.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fan Belts: One set for each individual fan.

1.4 QUALITY ASSURANCE

- A. AMCA Compliance: Provide products that meet AMCA certified performance and sound ratings and are licensed to use the AMCA Seal.
- B. UL Compliance: Fans and fan motors shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."
- C. Kitchen Hood Exhaust Fans: Kitchen hood exhaust fans and components shall comply with requirements of UL 762 and NFPA 96.
- D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- F. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

1.6 FIELD CONDITIONS

- A. Permanent fans may not be used for ventilation during construction.

PART 2 - PRODUCTS AND MATERIALS

2.1 POWER VENTILATORS - GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished; with indicated capacities and characteristics.
- B. Statically and Dynamically Balanced: Fans and shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
 - 1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

- C. Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210.
- D. Sound Ratings: Comply with AMCA 301. Test fans in accordance with AMCA Standard 300.
- E. Fabrication: Comply with AMCA 99.
- F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor: 1.4.
- G. Belts: Oil-resistant, non-sparking, and non-static.
- H. Motors: Refer to Section “Common Motor Requirements for HVAC Equipment” for requirements.
- I. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 - 1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.
- J. Hazardous Duty: Provide fans with spark resistant construction and explosion proof motor where specified in the schedule.
- K. Factory Finish: The following finishes are required:
 - 1. Sheet Metal Parts: Prime coating prior to final assembly.
 - 2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.2 ROOF VENTILATORS

- A. Manufacturers:
 - 1. Accurex.
 - 2. Acme Engrg. & Mfg. Corp.
 - 3. Carnes Company, Inc.
 - 4. Cook (Loren) Co.
 - 5. Greenheck Fan Corp.
 - 6. Hartzell Fan, Inc.
 - 7. PennBarry.
 - 8. RuppAir Management Systems.
 - 9. Twin City Fan Company.
- B. Fan Unit: Belt-driven or direct-drive as indicated, centrifugal or axial fan, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Roof Curbs: Refer to Section “Hangers and Supports for HVAC” for pre-engineered roof equipment supports .
- E. Fan Wheel: Aluminum hub and wheel.
- F. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. For centrifugal fans, fan and motor shall be isolated from exhaust air stream.

G. Accessories: Provide the following items as indicated:

1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Maximum 1/2-inch mesh, 16-gage, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.
4. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.

2.3 WALL EXHAUSTERS

A. Manufacturers

1. Accurex.
2. Acme Engrg. & Mfg. Corp.
3. Carnes Company, Inc.
4. Cook (Loren) Co.
5. Greenheck Fan Corp.
6. Hartzell Fan, Inc.
7. PennBarry.
8. RuppAir Management Systems
9. Twin City Fan Company

B. Fan Unit: Belt-driven or direct-drive as indicated, centrifugal or axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi design fan inlet cone.

D. Fan Wheel: Aluminum hub and wheel.

E. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. For centrifugal fans, fan and motor shall be isolated from exhaust air stream.

F. Accessories: Provide the following items as indicated:

1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Maximum 1/2-inch mesh, 16-gage aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade backdraft dampers mounted in curb base, factory set to close when fan stops.
4. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.

2.4 CABINET EXHAUST FANS

A. Manufacturers:

1. Acme Engrg. & Mfg. Corp.
2. Carnes Company, Inc.

3. Cook (Loren) Co.
 4. Greenheck Fan Corp.
 5. PennBarry.
 6. RuppAir Management Systems.
 7. Twin City Fan Company
- B. Centrifugal Fan Unit: Centrifugal fan designed for installation in ceiling, wall, or concealed inline applications.
- C. Housing: Galvanized steel lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Grille: Molded white plastic], louvered grille with flange on intake and thumbscrew attachment to fan housing.
- G. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- H. Accessories: Provide the following items as indicated:
1. Remote Fan Speed Control: Solid state, capable of controlling fan speed from full speed to approximately half speed.
 2. Manufacturer's standard roof jack, wall cap, and transition fittings for exhaust termination as indicated.

2.5 UPBLAST ROOF EXHAUSTERS

- A. Manufacturers:
1. Accurex.
 2. Acme Engrg. & Mfg. Corp.
 3. Carnes Company, Inc.
 4. Cook (Loren) Co.
 5. Greenheck Fan Corp.
 6. Hartzell Fan, Inc.
 7. PennBarry.
 8. RuppAir Management Systems
 9. Twin City Fan Company
- B. General Description: Belt-driven or direct-drive as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Fan Wheel:
1. Type: Non-overloading centrifugal, propeller or axial blades as scheduled
 2. Material: Aluminum ,
- D. Housing:
1. Construct of heavy-gage aluminum including curb cap, windband and motor compartment..

2. Rigid internal support structure.
 3. One-piece fabricated or fully welded curb-cap to windband for leak proof construction.
 4. Wind Band and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
 - a. Dampers Rods: Steel with bronze or nylon bearings.
 5. Provide breather tube for fresh air motor cooling and wiring.
- E. Shafts and Bearings:
1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 2. Bearings
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 50,000 hours.
- F. Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 2. Belts: Static free and oil resistant.
 3. Pulleys: Cast-iron, adjustable-pitch, keyed and securely attached to the wheel and motor shafts..
- G. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports.
- H. Drain Trough: Provides single point drainage for water or other residue.
- I. Accessories: Provide the following items as indicated:
1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
 2. Bird Screens: Maximum 1/2-inch mesh, 16-gage aluminum or brass wire.
 3. Dampers: Counter-balanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
 - a. Blades: Die-formed sheet aluminum.
 - b. Frame: Extruded aluminum, with waterproof, felt blade bumpers.
 - c. Linkage: Nonferrous metals.
 - d. Operators: Manufacturer's standard electric actuator.
 - e. Operators: Manufacturer's standard pneumatic actuator.
 5. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.

2.6 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
1. Acme Engrg. & Mfg. Corp.
 2. Carnes Company, Inc.
 3. Cook (Loren) Co.
 4. Greenheck Fan Corp.
 5. PennBarry.
 6. RuppAir Management Systems.
 7. Twin City Fan Company
- B. Fan Unit: Inline, belt or direct driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

- C. Housing: Galvanized steel or split, spun-aluminum housing, with straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Wheel: Aluminum, forward curved, backward inclined or airfoil blades welded to aluminum hub.
- E. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.
- F. Belt-Drive Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing. Provide self-aligning pre-lubricated ball bearings.
- G. Accessories: Provide the following accessories as indicated:
 1. Volume Control Damper: Manual operated with quadrant lock, located in fan outlet.
 2. Companion Flanges: For inlet and outlet duct connections.
 3. Fan Guards: Expanded metal in removable frame.
 4. Speed Control: Variable speed switch with on-off control and speed control for 100 to 50 percent of fan air delivery.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.

3.2 INSTALLATION

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
- B. Secure roof-mounted fans to pre-engineered roof equipment supports in accordance with the requirements specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Cabinet Units: Suspend units from structural steel support frame using steel wire or metal straps.
- D. Install vibration isolation for equipment as specified in Division 23 Section "Vibration Isolation for HVAC Piping and Equipment."
- E. Arrange installation to provide access space around fans for service and maintenance.

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.4 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Shut unit down and reconnect automatic temperature control operators.
4. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.5 DEMONSTRATION

A. Demonstration Services: Train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION

SECTION 15933 (233600) - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable Air Volume Terminal Units
 - 1. Shutoff Single Duct
 - 2. Reheat

1.2 REFERENCE STANDARDS

- A. AHRI 410 – Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. AHRI 880 – Performance Rating of Air Terminals.
- C. AHRI 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- D. ASHRAE Std 130 – Methods of Testing Air Terminal Units.
- E. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
- F. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors.
- G. UL 94 – Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; certified sound power data for each unit; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components and electrical characteristics and connection requirements.
- C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- D. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
- E. Nameplate Data: Nameplate data shall be submitted in a timely manner so as to allow proper coordination with the Electrical Contractor. Submittals that do not have nameplate data will be rejected.
- F. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

- G. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- H. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

- A. ADC Compliance: Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.
- B. UL/ETL Compliance: Air terminal units shall be UL or ETL listed as a complete assembly. All electrical components shall be UL listed and installed in accordance with the National Electric Code.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 SPARE PARTS

- A. If HVAC equipment is used during construction, the contractor is fully responsible for it's cleaning just before substantial completion prior to testing and balancing.

PART 2 - PRODUCTS

2.1 VARIABLE AND CONSTANT AIR VOLUME TERMINAL UNITS

- A. Manufacturers:
 - 1. Carnes Co.
 - 2. Carrier Corp.; Sub. of United Technologies Corp.
 - 3. Environmental Technologies, Inc.
 - 4. Johnson Controls, Inc.
 - 5. Krueger Mfg. Co.
 - 6. Metalaire.
 - 7. Nailor Industries, Inc.
 - 8. Price Industries.
 - 9. Tempmaster Corp.
 - 10. Titus Products Div.; Philips Industries, Inc.
 - 11. Trane (The) Co.
- B. Construction
 - 1. Casings: Construct of galvanized sheet metal of minimum 22 gauge thickness or die-cast aluminum of minimum 20 gauge thickness.
 - a. Assembled with longitudinal lock seam construction.
 - b. Construct casings such that when subjected to 0.5-in w.g. pressure for low pressure units, and 3.0-in w.g. pressure for high pressure units, total leakage does not exceed 2% of specified air flow capacity with outlets sealed and inlets wide open.

2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes or rectangular where needed to meet airflow requirements.
 3. Unit Discharge: Rectangular, with slip-and-drive connections.
 4. Acceptable Liners:
 - a. Linings: Line inside surfaces of casings with fiberglass, lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1/2". Secure lining to prevent delamination, sagging, or settling.
 5. Access: Provide removable panels in casings to permit access to air dampers, fans and other parts requiring service, adjusting, or maintenance.
 - a. Provide airtight gasket and quarter-turn latches.
 6. Provide hanger brackets for attachment of supports.
 7. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.
- C. Primary Air Damper Assembly
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 3. Incorporate low leak damper blades for tight airflow shutoff.
 - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 inch wg inlet static pressure, tested in accordance with ASHRAE Std 130.
- D. Electric Heating Coil:
1. Listed, open-coil design, factory-installed and slip-in-type, fully wired including integral control box.
 2. 80/20 nickel-chrome heating elements.
 3. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
 4. Mercury contactors.
 5. Secondary/primary over temperature protection.
 6. Airflow switch.
 7. Step Controller: Magnetic contactor (3-phase units only).
 8. Disconnect switch (non-interlocking).
 9. Fuses.
 10. Provide SCR (Silicon Controlled Rectifier) controller where indicated on the equipment schedule.
- E. Electrical Requirements:
1. Single-point power connection.
 2. Equipment wiring to comply with requirements of NFPA 70.
 3. All electrical components shall be UL or ETL listed or recognized and installed in accordance with the National Electrical Code.
 4. All electrical components shall be mounted in a control box.
 5. The entire assembly shall be UL or ETL listed (cETL in Canada) and so labeled.
- F. Control Transformers: Factory supplied and mounted for electric and electronic control applications.
- G. Controls: Provide controls accurate to 1.5 degrees F and adjustable from 65 degrees F to 85 degrees F. Provide air flow measurement station at terminal unit inlet. Provide control type as indicated below.
1. DDC (Direct Digital Control): Provide direct digital controls, compatible with direct digital control system specified in other Division 23 sections.
 - a. The unit level controller to include the following:
 - 1) 24 VAC power terminal or RJ-12 Power connection.

- 2) Port for thermostat connection.
- 3) Service Port for diagnostic equipment.
- 4) Damper actuator.
- 5) LED indication for troubleshooting.
- 6) Heating output signal(s).
- 7) Cooling output signal(s).
- 8) Supply air temperature sensor input.
- 9) Contact closure input.
- 10) BACNET communication capability.
- b. Include a factory-installed, unit-mounted direct-digital controller.
- c. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
- d. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
 - 1) Occupied and unoccupied operating mode.
 - 2) Remote reset of temperature or CFM set points.
 - 3) Proportional, plus integral control of room temperature.
 - 4) Monitoring and adjusting with portable terminal.
 - 5) Time-proportional reheat coil control.
- e. Room Sensor:
 - 1) Compatible with temperature controls specified.
 - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - a. Sensor Requirements:
 - 1) Plastic parts shall be fire-resistant, complying with UL 94.
 - 2) Control tubing shall be protected by grommets at the wall of the air flow sensor's housing.
 - 3) Furnished with multiple total and static pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
 - 4) Provide sensor with a pressure transducer to interface with the building control system.
 - b. Signal accuracy: Provide accuracy within 5 percent throughout the terminal unit operating range.
- H. Identification: Provide label on each unit indicating Plan Number, cfm range, cfm factory-setting, and calibration curve (if required).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.

- C. Provide ceiling access doors or locate units above easily removable ceiling components.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to scheduled minimum flow.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, duct connections to air terminals, and water coils are leak-tight.
 - 1. Leak Test:
 - a. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.
 - b. Repair water leaks and retest until no leaks exist.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Test and adjust controls and safeties.
 - c. Replace damaged and malfunctioning controls and other equipment.

3.5 CLEANING

- A. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust.

END OF SECTION

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SECTION 15932 (233713) - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ceiling air diffusers.
- B. Registers and grilles.
- C. Drop box diffusers.
- D. Louvers.

1.2 REFERENCE STANDARDS

- A. ADC 1062 – Certification, Rating and Test Manual.
- B. AHRI 880 – Performance Rating of Air Terminals.
- C. AHRI 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets (with Addendum 1)
- D. AMCA 500 – Test Method for Louvers, Dampers and Shutters.
- E. ASHRAE 70 – Method of Testing the Performance of Air Outlets and Inlets.
- F. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
- H. NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- I. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details. Indicate selections on product data.
 - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings at specified airflows.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

- D. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.
- E. Color Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

1.4 QUALITY ASSURANCE

- A. Test and rate air outlets and inlets in accordance with ASHRAE 70.
- B. Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062.
- C. Provide air outlets and inlets bearing ADC Certified Rating Seal.
- D. Test and rate sound data for air outlets and inlets in accordance with AHRI 885.
- E. Install air outlets and inlets in accordance with NFPA 90A.
- F. Test and rate louvers in accordance with AMCA 500.

1.5 SPARE PARTS

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS

- A. Manufacturers
 - 1. Carnes Co.
 - 2. Krueger Mfg. Co.
 - 3. Metalaire; Metal Industries, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Price Industries, Inc.
 - 6. Titus HVAC
 - 7. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- E. Types: Provide ceiling air diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

2.2 REGISTERS AND GRILLES

- A. Manufacturers
 - 1. Carnes Co.
 - 2. Krueger Mfg. Co.
 - 3. Metalaire; Metal Industries, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Price Industries, Inc.
 - 6. Titus HVAC
 - 7. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of register and grille.
- E. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.
- F. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.

2.3 DROP BOX DIFFUSERS

- A. Manufacturers
 - 1. AES Industries
 - 2. Carnes Co.
 - 3. EP Custom Products
 - 4. Kees
 - 5. Plenums Inc.
 - 6. Ruskin
- B. General: Except as otherwise indicated, provide manufacturer's standard drop box diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide drop box diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Construction: Drop box diffusers shall be minimum 22 gauge galvanized steel construction, factory assembled and welded, and provided with standard duct connections and mounting brackets for field installation. Diffusers shall have double deflection grilles or drum louvers that are individually adjustable to customize horizontal and vertical throws and factory installed air diverters or turning vanes.
- E. Diffusers shall be insulated with 1" thick, 1.5 lb duct liner insulation.

F. Diffusers shall have be factory primed and painted, color as selected by the Architect.

2.4 LOUVERS

A. Manufacturers: Subject to compliance with requirements, provide louvers of one of the following:

1. American Warming & Ventilating Inc.
2. Arrow United Industries, Inc.
3. Carnes Co.; Div. of Wehr Corp.
4. Cesco
5. Greenheck
6. Industrial Louvers, Inc.
7. Louvers & Dampers, Inc.
8. Nailor Industries, Inc.
9. Pottorff
10. Ruskin Mfg. Co.
11. Tampco.

B. General: Except as otherwise indicated, provide manufacturer's standard louvers as scheduled or indicated on the drawings; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.

C. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

1. Structural Performance: Louvers shall withstand the effects of gravity loads and wind and/or seismic loads as defined in the applicable building code for the installed location without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
2. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions to meet seismic requirements specified on the drawings or in Division 23 Section 230548 "Seismic Controls for Mechanical Systems". Component importance factor shall be 1.0.

D. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

E. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

F. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

G. Louver Supports: Louver design shall limit span between visible mullions to 10' and shall incorporate structural supports required to withstand a wind load of 20 lbs. per sq. ft.

H. Intermediate Blade Supports: Where needed blade supports shall be provided by louver manufacturer on the rear of blade only.

I. Louver Blank-Off Panels: Blank off any unused portions of louver with lined galvanized sheet metal panels and seal airtight. Back of panels shall be insulated with 1" thick, 3 lb. density duct liner.

J. Special Considerations:

- 1.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.
- C. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 section "Air Duct Accessories".
- D. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.
- E. Linear Slot Diffuser Installation:
 - 1. For installations in a hard ceiling, install diffuser prior to installation of drywall. Use manufacturer's hard ceiling clips for mounting to ceiling framing. Screws through face of diffuser are not acceptable.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before beginning air balance.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION

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SECTION 15885 (234100) - PARTICULATE AIR FILTRATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of air cleaning work required by this Section is indicated on drawings and schedules, and by requirements of this Section.
- B. Types of air cleaning equipment specified in this Section include the following:
 - 1. Air Filters
 - a. Cleanable (washable)
 - b. Replaceable (throwaway) panel and pleated
 - 2. Filter Holding Systems
 - a. Front and Rear Access Filter Frames
 - b. Side Servicing Housings
- C. Filter sections of packaged air handling units are work of this section.

1.2 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B, and NEC pertaining to installation of air filters and associated electric wiring and equipment.
 - 2. UL Compliance: Comply with UL Standards pertaining to safety performance of air filter units.
 - 3. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.
 - 4. AHRI Compliance: Comply with provisions of AHRI Standard 850 pertaining to test and performance of air filter units.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for filter rack assemblies indicating dimensions, materials, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter and rack required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.4 SPARE PARTS

- A. Provide one complete spare set of filters of each type required for each air handling system. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide air cleaning equipment of one of the following:
 - 1. Air Filters
 - a. AAF/Flanders.
 - b. Bioclimatic Air Systems
 - c. Columbus Industries, Inc..
 - d. Camfil Farr.
 - e. Filtration Group
 - f. Koch Filter Corp.
 - g. Research Products Corp.

2.2 AIR FILTERS

- A. Replaceable (Throwaway) Panel Filters: Provide factory-fabricated, viscous-coated, panel type replaceable air filters with holding frames; as indicated, in sizes indicated or sized for maximum velocity indicated, with 2" thick UL Class 2 throwaway media material; construct media of interlaced glass fibers, spray with non-flammable adhesive, frame in throwaway fiberboard casings, and sandwich between perforated metal grilles. Construct ductwork-holding frames of 20-ga galvanized steel, capable of holding media and media frame in place, and gasketed to prevent unfiltered air by-passing between media frames and holding members. Provide filters with rated face velocity of 500 fpm, initial resistance of not greater than 0.30" w.g., final rated resistance of 0.90" w.g., and average arrestance of 80 percent.
- B. Replaceable (Throwaway) Pleated Filters: Provide factory-fabricated, pleated type, replaceable air filters with holding frames; as indicated, in sizes indicated or sized for maximum velocity indicated, with 2 inch thick UL Class 2 throwaway media material. Construct filter of a synthetic media, framed in throwaway fiberboard casings with diagonal bracing to adequately support the media on the entering and exiting side of the filter. Provide media support grid of welded wire construction coated with rust inhibitor. Construct ductwork-holding frames of 20-ga galvanized steel, capable of holding media and media frame in place, and gasketed to prevent unfiltered air by-passing between media frames and holding members. Provide 2 inch filters with initial resistance of not greater than 0.40 inches w.g. for 2 inch thick at 500 fpm. Filters shall have final rated resistance of 0.9 inches w.g. or greater, average efficiency of 85 percent and average arrestance of 98 percent. The minimum MERV when tested under ASHRAE 52.2 shall be no less than MERV 13.

2.3 FILTER HOLDING SYSTEMS

- A. Front and Rear Access Filter Frames: Provide filter bank framing system, constructed of aluminum framing members having minimum thickness of 0.09". Design system for either upstream (front) or downstream (rear) filter servicing. Cut to size and pre-punch members for each assembly into modules of size and capacity or maximum velocity as scheduled or noted on drawings. Provide permanently gasketed framing members to prevent bypass of unfiltered air. If vertical support members are required to prevent deflection of horizontal members, install so as not to interfere with either installation or operation of filters. Incorporate separate track for prefilters, removable from front, or removable from back after removal of after-filters. Provide factory-installed positive sealing device for each row of filters, to insure seal between gasketed filter elements. Provide hardware necessary for field assembly.
- B. Side Servicing Housings: Provide factory-assembled side servicing housings with flanges for insertion into ductwork system as indicated. Construct of 16-ga galvanized steel. Provide integral pre-filter tracks to accommodate 2" throw-away or cleanable filters. Provide access doors with continuous gasketing on

perimeter and positive locking devices. Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass. Arrange so filter cartridge can be loaded from either access door.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housing/casings, and associated supporting devices.
- B. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.
- C. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.
- D. Coordinate with other work including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.
- E. Install filters in proper position to prevent passage of unfiltered air.

END OF SECTION

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SECTION 15792 (238126) - SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.
 - 1. Indoor evaporator fan coil units.
 - 2. Outdoor condenser units.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections apply to this Section.
- B. Section 221300 - Plumbing Piping for condensate drains.
- C. Section 230500 – Common Work Results for HVAC for concrete, reinforcement, and formwork requirements.
- D. Section 230529 – Hangers and Supports for HVAC Piping and Equipment.
- E. Section 230550 – Vibration Isolation for HVAC Piping and Equipment.
- F. Section 230593 - Testing, Adjusting, and Balancing for HVAC for unit balancing.
- G. Section 230913 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, timeclocks.
- H. Section 230923 – Direct Digital Control for HVAC for installing external control components.
- I. Section 232300 – Refrigerant Piping for refrigerant piping connecting the system.
- J. Section 233113 – Metal Ducts for ductwork connecting to units.
- K. Section 262717 – Equipment Wiring: Electrical characteristics and wiring connections.
- L. Section 233300 – Air Duct Accessories.

1.3 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; most current edition.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; most current edition.
- C. NFPA 70 – National Electric Code.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power

characteristics, motor requirements, type of refrigerant used, refrigerant pipe sizing, and electrical characteristics. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

- B. Shop Drawings: Provide drawings that indicate size, profile, dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- D. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, accessories, and trouble-shooting guide.
 - 1. Include manufacturer's recommended maintenance schedule of units installed in a seacoast application, within 5 miles of the coast.
- E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Units shall be designed to operate with HCFC-free refrigerants.
- D. Units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 and bear the Listed Mark.
- E. The system components shall be rated in accordance with AHRI Standard 210/240, Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.

1.6 COORDINATION

- A. Coordinate layout and installation of units and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction and actual equipment provided. Roof specialties are specified in Division 7 Sections. Concrete, reinforcement and formwork are specified in Division 3 Sections.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 - 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Substantial Completion.

1.8 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Fan Belts: One set for each belt-drive fan.
 2. Gaskets: One set for each access door.
 3. One set of spare filters of each type required for each unit.
 4. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier.
 2. Daikin US Corporation.
 3. Friedrich Air Conditioning Company.
 4. Lennox Industries, Inc..
 5. LG.
 6. Mitsubishi Electric & Electronics USA, Inc.
 7. Panasonic.
 8. Trane.
 9. York.

2.2 INDOOR UNITS

- A. General: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
- B. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- C. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
- D. Motor: Comply with NEMA designation temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- E. Air Filters: Washable type for wall-mount units, minimum 1 inch thick throwaway type for all other units, unless scheduled otherwise.
- F. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
- G. Electric Heating Coil: Nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

- H. Gas Furnace: Atmospheric burner, gas valve with 100 percent safety gas shut-off; pressure regulation, safety pilot, manual set (On-Off), pilot filtration, and automatic electric valve.
 - 1. Burner Safety Controls:
 - a. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 - b. Flame Rollout Switch: Installed on burner box and prevents operation.
 - c. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 - d. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic reset.
- I. Controls: Unit-mounted panel with contactors, control transformer with circuit breaker, solid-state temperature- and humidity-control modules, time-delay relay, and thermostat.
- J. Where scheduled on the drawings, provide condensate lift pump with a built-in safety cutoff switch and integral check valve on discharge.

2.3 OUTDOOR UNITS

- A. General: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
- B. Air-Cooled Condenser:
 - 1. General: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - 2. Casing: Steel, baked enamel finish, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 - 3. Compressor: Hermetic scroll-type with resilient suspension system, oil strainer, crankcase heater, start capacitor, relay, contactor, and internal motor overload protection.
 - 4. Accessories:
 - a. Liquid line filter drier.
 - b. High pressure switch (manual reset).
 - c. Low pressure switch (automatic reset).
 - d. Service valve with gauge ports.
 - e. Thermometer well in liquid line.
 - f. Low-ambient kit where scheduled.
 - g. Compressor short-cycling controls.
 - h. Reversing valve for heat pump units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine area for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify that flooring or ceiling system is ready to receive work and opening dimensions are as indicated on Shop Drawings.
- C. Verify that power supply is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Install unit level and plumb.
- C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- D. Install roof-mounted, compressor-condenser components on roof equipment supports with vibration isolation. Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base or polyethylene mounting base with vibration isolators.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping. The following are specific connection requirements:
 1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
 2. Connect piping to air-handling units with flexible connectors.
 3. Connect water supply piping to the air leaving side of water coils.
 4. Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Route unit condensate drain to location shown on the drawings or, if not shown, to nearest indirect waste connection. Provide trap at drain pan, minimum of 1 inch deeper than fan pressure in inches of water, and install cleanouts at changes in direction. Size condensate drain piping in accordance with local code and the following:

<u>Piping Length</u>	<u>Size</u>
Less than 10 feet	Same size as unit connection
More than 10 feet	One pipe size larger than unit connection

- D. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect ductwork to units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories." Provide transitions to exactly match unit duct connection size.

3.4 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust fan for required airflow in accordance with Section "Testing, Adjusting and Balancing." Tighten belts as required for proper operation.
- B. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.
- C. Adjust damper linkages for proper damper operation.
- D. Set initial temperature and humidity set points.
- E. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.5 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping, blocking, and bracing.
 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects. Verify vibration isolation and flexible connections are installed correctly.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
 7. Comb coil fins for parallel orientation.
 8. Install new filters at completion of installation and prior to testing, adjusting, and balancing. Do not operate air handling unit without pre-filters installed.
 9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
 10. Disable automatic temperature control operators.
- B. Start-Up Services: Start-up units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.7 DEMONSTRATION

1. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.
2. Content: Training shall include but not be limited to:
 - a. Overview of the system and/or equipment as it relates to the facility as a whole.
 - b. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.

- c. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
3. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
4. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

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SECTION 15787 (238149) - ROOFTOP HEAT PUMP UNITS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Section includes package rooftop heating and cooling heat pump units.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
- B. Shop Drawings:
 - 1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components
 - 2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.
- C. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling heat pump units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Operation and Maintenance Data: Submit maintenance data and parts list for each heat pump unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Testing and rating of rooftop units of 135,000 btu/hr capacity or over shall be in accordance with AHRI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".
 - 2. Testing and rating of rooftop units under 135,000 btu/hr capacity shall be in accordance with AHRI 210 "Standard for Unitary Air-Conditioning Equipment", and provide Certified Rating Seal. Sound testing and rating of units shall be in accordance with AHRI 270 "Standard for Sound Rating of Outdoor Unitary Equipment". Units shall bear Certified Rating Seal.
 - 3. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
 - 4. Energy Efficiency Ratio (EER) of rooftop units shall be equal to or greater than prescribed by ASHRAE 90.1-2004 "Energy Standard For Buildings Except Low-Rise Residential Buildings".
 - 5. Rooftop units shall be listed by UL and have UL label as a unit.
 - 6. Rooftop units shall be designed, manufactured, and tested in accordance with UL requirements.

1.4 SPARE PARTS

- A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling heat pump unit:
 - 1. One set of matched fan belts for each belt-driven fan.

2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
3. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

1.5 SPECIAL WARRANTY

- A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
 1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.1 ROOFTOP HEAT PUMP UNITS LESS THAN 20 TONS

- A. Manufacturers: Subject to compliance with requirements, provide rooftop heat pump units of one of the following:
 1. Aaon, Inc.
 - a. Rob Teis – Sales Engineer, AAON Inc., robt@aaon.com, p: 918-382-6134
 2. Lennox Industries, Inc.
 - a. Eddie Chavez – Strategic Account Manager, Lennox International,
- B. General Description: Units shall be factory-assembled and tested, designed for roof installation, and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics are scheduled on the Drawings.
- C. Casing: Manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1/2" thick thermal insulation, knockouts for electrical and piping connections and an exterior condensate drain connection and lifting lugs.
- D. Roof Curbs: Refer to Section "Vibration Isolation for HVAC Piping and Equipment" for vibration isolation curbs. Curb shall be sloped to match roof structure to enable the rooftop unit to be installed level.
- E. Evaporator Fans: Forward-curved, centrifugal, belt-driven fans with adjustable sheaves or direct-driven fans; and permanently lubricated motor bearings.
- F. Condenser Fans: Propeller-type, direct-driven fans with permanently lubricated bearings.
- G. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.
- H. Coils:
 1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall

- be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.
2. Water Coils: Continuous tube type, designed for 200 psi working pressure and pressure tested to 300 psig with air pressure under water.
 3. Refrigerant Cooling Coils: Coils shall have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be designed for 300 psig working pressure and pressure tested at 450 psig., then cleaned, dehydrated, and sealed with a holding charge of refrigerant. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.
- I. Compressors: Provide serviceable, semi-hermetic, or fully hermetic compressors, complete with integral vibration isolators and crankcase heaters.
1. For heat pump units, provide reversing valve, suction line accumulator, flow control check valve, and solid state defrost control utilizing thermistors.
- J. Safety Controls: Provide manual reset type for:
1. Low pressure cutout;
 2. High pressure cutout;
 3. Compressor motor overload protection.
- K. Electric Heat Sections: Provide electric heat coils, of manufacturer's standard construction, factory-wired for single point wiring connection, complete with over-current and over-heat protection devices.
- L. Dampers:
1. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."
 2. Outdoor Air Damper:
 - a. Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
 - b. Refer to schedules on the drawings for capacity and control method of the outdoor air damper of each unit.
- M. Economizer Control:
1. Provide economizer system complete with return and outside air dampers, outside air filter, fully modulating electric control system with dry bulb or enthalpy economizer control as scheduled on the drawings, and adjustable mixed-air thermostat.
 2. System shall have 100 percent outside air capability.
 3. Provide automatic changeover through adjustable control device.
- N. Relief Control:
1. Power Exhaust Fan: Direct drive, propeller type designed for low tip speed. Motors shall be open drip-proof with internal motor protection and permanently lubricated ball bearings.
 2. Damper: Include a relief damper with control type as scheduled on the drawings.
- O. Filters Section: Provide 1" thick for units 7-1/2 tons and smaller, 2" thick for units larger than 7-1/2 tons, throwaway pleated filters, Farr 30/30 or approved equal, in filter rack, with maximum face velocity of 400 fpm. Filters shall have minimum MERV rating per ASHRAE 52.2 of MERV 7.
- P. Electrical: Units shall have a 115 VAC convenience outlet, separately fused, for unit service. Unit power connection shall be either through unit cabinet or within roof curb perimeter. Rooftop units shall be designed to meet the minimum short-circuit withstand rating specified on the drawings.

- Q. Accessories: Units shall include the following accessories:
1. Low ambient control head pressure control, designed to operate at temperatures down to 25 deg F, where indicated on schedule.
 2. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard subbase. Refer to controls specification, Section 17110.
 3. Provide guards to protect the condenser coil from hail or other damage.
 4. Provide birdscreens on outside air inlets to unit.

2.2 ROOFTOP HEAT PUMP UNITS 20 TONS AND LARGER

- A. Manufacturers: Subject to compliance with requirements, provide rooftop units of one of the following:
1. Aaon, Inc.
 - a. Rob Teis – Sales Engineer, AAON Inc., robt@aaon.com, p: 918-382-6134
 2. Lennox Industries, Inc.
 - a. Eddie Chavez – Strategic Account Manager, Lennox International,
- B. General Description: Rooftop unit shall be factory-assembled and tested, designed for roof installation and, consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics are scheduled on the Drawings.
- C. Casing shall be manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1" thick thermal insulation, knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs.
- D. Roof Curbs: Refer to Section "Vibration Isolation for HVAC Piping and Equipment" for vibration isolation curbs. Curb shall be sloped to match roof structure to enable the rooftop unit to be installed level.
1. Overall Roof Curb Height: Minimum 12 inches for roofs with no insulation, 15" for roofs with insulation or as scheduled on the drawings.
- E. Evaporator Fans: Forward-curved, centrifugal, belt-driven fans with adjustable sheaves; and permanently lubricated motor bearings.
- F. Condenser Fans: Propeller-type, direct-driven fans with permanently lubricated bearings.
- G. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.
- H. Coils:
1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.
 2. Continuous tube type, and proof (300 psig) and leak (200 psig) tested with air pressure under water.
 3. Refrigerant Cooling Coils: Coils shall have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of refrigerant. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.

- I. Compressors: Provide serviceable, semi-hermetic, or hermetic compressors with integral vibration isolators, and crankcase heaters which de-energize during compressor operation. Units shall also have:
 - 1. Cylinder unloaders for capacity control, with minimum steps as scheduled.
 - 2. For heat pump units, provide reversing valve, suction line accumulator, flow control check valve, and solid state defrost control utilizing thermistors.
 - 3. Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors; and fan-cycling control for low ambient control to 25 deg F (2 deg C).

- J. Safety Controls: Provide the following:
 - 1. Low pressure cutout, manual reset;
 - 2. High pressure cutout, manual reset;
 - 3. Compressor motor overload protection, manual reset;
 - 4. Anti-recycling timing device;
 - 5. Adjustable low-ambient lockout;
 - 6. Oil pressure switch.

- K. Electric Heat Sections: Provide manufacturer's standard construction electric heat coils, factory-wire for single point wiring connection, complete with over-current and over-heat protection devices.

- L. Dampers:
 - 1. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."
 - 2. Outdoor Air Damper:
 - a. Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
 - b. Refer to schedules on the drawings for capacity and control method of the outdoor air damper of each unit.

- M. Economizer Control:
 - 1. Provide economizer system complete with return and outside air dampers, outside air filter, fully modulating electric control system with dry bulb or enthalpy economizer control as scheduled on the drawings, and adjustable mixed-air thermostat.
 - 2. System shall have 100 percent outside air capability.
 - 3. Provide automatic changeover through adjustable control device.

- N. Relief Control:
 - 1. Power Exhaust Fan: Direct drive, propeller type designed for low tip speed. Motors shall be open drip-proof with internal motor protection and permanently lubricated ball bearings.
 - 2. Damper: Include a relief damper with control type as scheduled on the drawings.

- O. Filters Section: 2" thick throwaway pleated filters, Farr 30/30 or approved equal, in filter rack, with maximum face velocity of 400 fpm. Filters shall have MERV rating per ASHRAE 52.2 of MERV 7.

- P. Variable Air Volume Control: Provide variable frequency drive to modulate fan to meet specified sequence of operation. Refer to Division 23 Section "Variable Frequency Drives".

- Q. Electrical: Units shall have a 115 VAC convenience outlet, separately fused, for unit service. Unit power connection shall be either through unit cabinet or within roof curb perimeter. Rooftop units shall be designed to meet the minimum short-circuit withstand rating specified on the drawings.

- R. Temperature Control: Provide factory-installed, demand-oriented solid-state control system with minimum of 2 cooling steps and 2 heating steps. Controls shall include solid-state thermostats with dead-band, and sub-base with system and fan switches. Other control features include:
 - 1. Discharge temperature reset capability with space temperature override;
- S. Accessories: Units shall include the following accessories:
 - 1. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.
 - 2. Low ambient control head pressure control, designed to operate at temperatures down to 25 deg F, where indicated on schedule.
 - 3. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard subbase. Coordinate with control system specification section.
 - 4. Provide guards to protect the condenser coil from hail or other damage.
 - 5. Provide birdscreens on outside air inlets to units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF ROOFTOP HEATING AND COOLING HEAT PUMP UNITS

- A. General: Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support: Support units on roof curb.
- C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.
- D. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
- E. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
 - 1. Condensate Drain Piping: Route condensate drain to nearest roof drain or to location shown on the drawings. Provide trap, minimum of 1" deeper than fan pressure in inches of water, at drain pan connection and install cleanouts at changes in direction (refer to manufacturer's recommendations for any additional requirements). Size condensate drain piping in accordance with local code and the following:

<u>Piping Length</u>	<u>Size</u>
Less than 10 feet	Same size as unit connection
More than 10 feet	One pipe size larger than unit connection

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust fan for required airflow in accordance with Section "Testing, Adjusting and Balancing for HVAC." Tighten belts as required for proper operation.

- B. Adjust damper linkages for proper damper operation.
- C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.4 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 - 1. Remove shipping, blocking, and bracing.
 - 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
 - 7. Comb coil fins for parallel orientation.
 - 8. Install clean filters. Do not operate air handling unit without pre-filters installed.
 - 9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
 - 10. Disable automatic temperature control operators.
- B. Start-Up Services: Provide the services of a factory-authorized service representative to start-up rooftop heat pump units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
 - 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 - 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 - 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

PART 1 - SECTION 16525 (25 5630) - SITE LIGHTING

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes:

1. Owner furnished exterior site lighting luminaires for installation by Contractor.
2. Owner furnished site lighting poles for installation by Contractor.
3. Site lighting accessories provided by Contractor.

B. Related Requirements:

1. Section 02300 - Earthwork: Trenching, backfill, and compaction for utilities.
2. Section 03311 – Site Structural Concrete: Concrete, reinforcement, and testing for light pole base.
3. Section 05120 – Structural Steel: Anchor bolts light pole base.
4. Section 16050 - Basic Electrical Materials and Methods: Grounding and bonding.
5. Section 16100 - Wiring Methods: Conduit, wire and cable.
6. Appendix A – Products and Work By Owner or Separate Contractor
 - a. General procedures related to Owner furnished products and transport, handle, store and protect products.(Formerly included in Section 01640)
 - b. Manufacturers, suppliers, and vendor contacts and product names and numbers related to Owner furnished products. (Formerly included in Section 01645)
7. Appendix B – Testing, Inspection, and Observation by Owner.

2.2 DELIVERY, STORAGE AND HANDLING

- A. Receive Owner furnished products in compliance with the requirements of Appendix A.
- B. Report substantial damage which will require pole replacement immediately to Wal-Mart Construction Manager.
- C. Handle, store, and protect products in compliance with the requirements of Section 01600 and manufacturer's recommendations.
- D. Do not use cutting instruments (i.e. knives) to remove pole packaging material.

PART 3 - PRODUCTS

3.1 OWNER FURNISHED PRODUCTS

- A. Owner's Site Lighting Vendor (hereinafter referred to as "vendor") will furnish lighting fixtures, lamps, and poles, as indicated on Drawings and as specified in Appendix A (Section 16525), for installation by Contractor.

3.2 SITE LIGHTING POLE ACCESSORIES (CONTRACTOR FURNISHED AND INSTALLED)

- A. Light Pole Base Pull Box (poles with security cameras): PVC, UL listed, CSA certified, NEMA 4X. Carlon E1212C24 with E1212DIV field installable divider. In the case of damage, provide Carlon replacement E1212L24.
- B. Light Pole Junction Box (poles with security cameras): NEMA 4, Hoffman A.
- C. Paved Area Pull Box: Quazite PG1730BA28 box 17" x 30" x 28" with PG1730HH00.

- D. Concrete: Concrete and reinforcement for light pole bases shall conform to the requirements specified in Section 03311. Anchor bolts shall conform to the requirements specified in Section 05120.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install Owner and Contractor furnished site lighting products in accordance with manufacturers' recommendations and as indicated on Drawings.
- B. Apply touch-up paint to site lighting poles.
- C. Provide electrical system for site lighting including wiring, conduit and exterior coating GRC bends and elbows for underground conduit as specified in Section 16100.
- D. Comply with the requirements for trenching and backfilling specified in Section 02300.
- E. Provide grounding of pole and fixture as indicated on Drawings and as specified in Section 16050.

4.2 MAINTENANCE AND REPLACEMENT DURING CONSTRUCTION

- A. Maintain lighting fixtures, lamps, ballast/drivers and poles during construction, possession, and until store Grand Opening. Coordinate replacement of defective, lost, or damaged equipment with site lighting vendor.
- B. Contractor Responsibility:
 - 1. Provide Performance Testing at least four weeks prior to Substantial Completion.
 - 2. Coordinate vendor on-site evaluation of abnormal component failures of ballast/driver and lamps at least two weeks prior to Substantial Completion. Provide labor for routine and normal maintenance of equipment including troubleshooting and determination of lighting failure.
 - 3. Provide material and labor for replacement of loss, breakage, or other damage due to fault of Contractor including lamps.
 - 4. Contact vendor to order replacement parts in time to have fixtures fully operational three weeks prior to Grand Opening.
- C. Replacement Procedure – General:
 - 1. Immediately notify vendor and request replacement of damaged fixtures, ballast/drivers, or lamps delivered to the jobsite.
 - 2. If shipping damage is concealed, notify carrier and vendor within 15 days of acceptance of freight. Provide vendor a copy of the written notification sent to the carrier.
- D. Additional Ballast/Driver Replacement Procedure:
 - 1. Order replacement ballast/driver from vendor. Request Return Authorization number from vendor to return defective ballast/driver no later than Grand Opening.
 - 2. Return all defective ballast/drivers to vendor. Vendor will arrange pickup and return, including shipping costs, of defective ballast/driver. Cost for ballast/driver not returned within the specific time frame or returned but not defective will be charged to the Contractor.
- E. Owner Responsibility:
 - 1. Costs for replacement by Owner is specified in Appendix A.

4.3 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except for specified mandatory testing, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified in Appendix B shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

- B. Performance Testing: Conduct parking lot lighting test at least four weeks prior to Substantial Completion consisting of dusk to dawn operation of luminaires and lamps for 100 hours. Do not energize fixtures during daylight hours to avoid liability for heat damage to fixtures. Witness and certify continuous operation and time duration of test. Replace defective components with replacement Owner furnished components in accordance with Appendix A. Reinstall components at least three weeks prior to Grand Opening.
- C. END OF SECTION

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SECTION 16100 (260010) - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and to all following sections within Division 26.

1.2 SECTION INCLUDES

- A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.
- B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 DEFINITIONS

- A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:
 - 1. Furnish: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
 - 2. Install: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."
 - 3. Provide: "To furnish and install complete, and ready for the intended use."
 - 4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: "An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
 - 5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division.
 - a. [A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased

involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".]

6. Contract Administrator: Where referenced in this Division, "Contract Administrator" is the primary liaison between the Owner and the Contractor. Specifically, for this project this is [the "Owner's Representative.
 7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 8. CLCATT: Certified Lighting Controls Acceptance Test Technician. A professional certified to perform acceptance tests and complete the documentation required for nonresidential acceptance tests as required by the California Building Energy Efficiency Standards. Technician shall be certified by an authorized lighting controls acceptance test technician certification provider.
 9. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
 10. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 11. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
 12. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified
- B. When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
- C. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- D. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 3. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference, unless otherwise noted.
- E. The following definitions apply to excavation operations:
 1. Additional Excavation: Where excavation has reached indicated sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. Sub-base: as used in this section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.

3. Sub-grade: as used in this section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

1.4 REFERENCE STANDARDS

- A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Engineer's attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.
- B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.
- C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.
- D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

IBC	International Building Code
CBC	California Building Code
CEC	California Energy Code
ADA	Americans with Disabilities Act
AIA	Guidelines for Design and Construction of Hospital and Healthcare Facilities
AEIC	Association of Edison Illuminating Companies
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
ICEA	Insulated Conductors Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code, NFPA 70
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers' Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
UL	Underwriter's Laboratories

- E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.
- G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.
- B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.
- C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.
- D. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
- E. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes installed.
- F. Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- G. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.
- H. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.
- I. Measurements and Layouts: The Drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not

completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.

1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
 6. Indicate required installation sequence to minimize conflicts between entities.
 7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
 2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
 3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
 4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
 3. Where Henderson Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, Henderson Engineers makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
 4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

- B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.
- C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- I. Refer to individual Sections for additional submittal requirements.
- J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- K. Submittals shall contain the following information:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. Equipment identification acronym as used on the drawings.
 - 4. The submittal date.
 - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 - 6. Submittals not so identified will be returned to the Contractor without action.
- L. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not

coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

M.

1.8 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the [Engineer, Architect, Construction Manager, and Owner] the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 2. Prior to receipt of Bids: No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
 - a. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 3. After receipt of Bids: No substitutions will be considered after receipt of Bids and before award of the Contract.
 4. After award of Contract: No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet.

- B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.
- C. Contact the Contract Administrator for written authorization.
- D. The following must be received before electronic drawing files will be sent:
 - 1. Contract Administrator's written authorization
 - 2. Engineer's release agreement form
 - 3. Payment

1.10 QUALITY ASSURANCE

- A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.
- B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.
- C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, username and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives.

1.12 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections of this Division

1.13 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.
- D. Be responsible for the safe storage of tools, material and equipment.

1.15 WARRANTIES

- A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.
- D. Also warrant the following additional items:
 - 1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
 - 2. All raceway seals are effective.

3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.
- E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.
- F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.
- G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.16 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
 2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees F. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.
 - a. Vent and exhaust fuel-burning heaters per SMACNA Guidelines for Source Control and equip units with individual-space thermostatic controls.
 - b. If permanent HVAC systems are used during construction, provide HVAC Protection and replace all filtration prior to occupancy in accordance with SMACNA Guidelines.

1.17 FIELD CONDITIONS

- A. :
- B. Conditions Affecting Excavations: The following project conditions apply:
 1. Maintain and protect existing building services that transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- D. Use of explosives is not permitted[, unless otherwise specified or allowed for powder-actuated tools].

- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

2.1 SOIL MATERIALS

- A. Sub base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than two inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.

3.2 EXISTING CONDITIONS

- A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.
- B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.
- C. Notify Contract Administrator immediately of any dangerous conditions that exist on the job site, as they are discovered, before demolition, during selective demolition or before remodel work begins.

3.3 EXISTING UTILITIES

- A. Prepare and submit a schedule of anticipated utility outages indicating dates and duration. Schedule
- B. Schedule and coordinate with the utility companies, Owner and with the Contract Administrator all connections to, relocation of, or discontinuation of normal utility services from any existing utility line. Include all premium time required for all such work in the bid.
- C. Repair all existing utilities damaged due to construction operations to the satisfaction of the Owner or utility companies without additional cost.
- D. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.
- E. Make repairs and restoration of utilities before workers leave the project at the end of the workday in which the interruption takes place.

- F. Include in bid the cost of furnishing temporary facilities to provide all services during interruption of normal utility service.

3.4 WORK IN EXISTING FACILITIES

- A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the site prior to submitting a bid, to determine the nature and extent of work involved.
- B. Schedule work in the existing facility with the Owner.
- C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves electrical systems, fixtures, conduit, wiring, equipment, equipment supports or foundations and materials.
- D. Remove all of these articles that are not required for the new work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.
- E. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner, or others, unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
 - 3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.
 - 4. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.
- F. Relocate and reconnect all electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical fixtures or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.
- G. Finish materials are specified in other divisions.
- H. Where removal of existing wiring interrupts electrical continuity of circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued electrical continuity.
- I. Penetrate roofs, channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all penetrations and channeling not specifically noted on the Drawings.
- J. Provide new, typewritten card directory for distribution equipment (including but not limited to load centers, panelboards, switchboards and switchgear) where changes occur under this scope of work. Indicate exact loads served by each existing circuit breaker or switch. Where circuit designations are not specifically indicated on the Drawings, provide a unique identifier for each updated circuit within the directory.
- K. Coordinate work with Architectural phasing drawings to properly stage transitions of work to provide power to existing, new and temporary loads. Monitor loads on distribution system to ensure shifting of loads does not overload electrical equipment.
 - 1. .

3.5 PERMITS

- A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.6 TEMPORARY ELECTRICAL SERVICE AND WIRING

- A. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.
- B. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.
- C. [Pay all charges made by the Electric Utility, with respect to installation and energy charges for temporary services.]
- D. [The Owner will pay all charges made by the Electrical Utility, with respect to installation and energy charges for temporary services.]
- E. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.
- F. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.
- G. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.
- H. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).
- I. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.
- J. If additional service is required for cranes, electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.
- K. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.
- L. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

3.7 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.
- C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.
- D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.
- E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- F. Slope sides of excavations to comply with local, state, and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state, and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks and Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.
 - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

- L. Trenching: Excavate trenches for electrical installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.
 2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
 5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 2. Under building slabs, use drainage fill materials.
 3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. ~~For raceway and cables less than 30 inches below surface of roadways, provide 4 inch thick concrete base slab support. After installation and testing of raceway and cables, provide a 4 inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.~~
 5. Other areas use excavated or borrowed materials.
- O. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.
- Q. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

T. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.8 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.9 PAINTING

- A. Refer to Division 09 Section "Painting" for painting requirements.
- B. .
- C. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.

- D. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.
- E. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.
- F. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.10 CLEANING

- A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Electrical Contractor shall clean material and equipment installed under the Electrical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment.
- C. Damaged finishes shall be touched-up and restored to their original condition

3.11 ACCEPTANCE TESTING REQUIREMENTS

- A. Perform acceptance test procedures in accordance with the specifications listed in the Reference Joint Appendices for the Building Energy Efficiency Standards of California. Reference the Non-Residential Certificate of Compliance (NRCC) forms on the drawings for the systems that shall be tested.
- B. .

3.12 ADJUSTING, ALIGNING AND TESTING

- A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.
- B. Check motors for alignment with drive and proper rotation, and adjust as required.
- C. Check and test protective devices for specified and required application, and adjust as required.
- D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.
- E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.
- F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.
- G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.
- H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.

- I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.
- J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.
- K. Refer to individual sections for additional and specific requirements.

3.13 START-UP OF SYSTEMS

- A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.
- B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.
- C. Adjust taps on each transformer for rated secondary voltages.
- D. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.
- E. Replace all burned-out lamps. Replace the lamps of all light fixtures that use incandescent, halogen or quartz lamp sources that are installed as part of the finished building, but are used by the Contractor during construction, with new lamps of appropriate type and wattage prior to turning the facility over to the Owner.
- F. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.
- G. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.
- H. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

3.14 TEST REPORTS

- A. Perform tests as required by these Specifications and submit the results to the Contract Administrator, for Engineer's review. Record the results, date and time of each test and the conditions under which the test was conducted. Include a copy of the finalized test results, with corrections made, in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.
- B. For specific testing requirements of special systems, refer to the Specification section that describes that system. The Contractor shall provide the following to facilitate the testing of the electrical systems:
 - 1. Perform tests as described in the individual sections;
 - 2. Engage the services of a 3rd Party testing agency to perform tests as noted below, or;
 - a. Agent may be an employee of the contractor but shall be NETA certified to perform electrical testing.
 - 3. The Owner will engage a 3rd Party agency to perform tests as noted below.
 - a. Provide assistance by making equipment available as required to perform the testing and notifying the appropriate Party(ies).

- C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:
 - 1. Building service entrance voltage and amperes at each phase.
 - 2. Electrical service grounding conditions and grounding resistance.
 - 3. Proper phasing throughout the entire system.
 - 4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
 - 5. Phase voltages and amperes at each three-phase motor.
 - 6. Test all wiring devices for electrical continuity and proper polarity of connections.

- D. Promptly correct all failures or deficiencies revealed by these tests in accordance with the manufacturer's recommendations and as determined by the Engineer.

3.15 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:
 - 1. Submit complete Operation and Maintenance Data.
 - 2. Submit complete Record Drawings.
 - 3. Perform all required training of Owner's personnel.
 - 4. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
 - 5. Perform start-up tests of all systems.
 - 6. Remove all temporary facilities from the site.
 - 7. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.

- B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days notice prior to the review.

- C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.

- D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.

- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, he shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.

- F. Upon completion of the review, the Contract Administrator will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

- H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor Date Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative Date Company

Engineer Review and Recommendation Section

Recommend Acceptance Yes No
Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature Date Company

Owner Acceptance Signature Date Company

Architect Acceptance Signature Date Company

Engineer Acceptance Signature Date Company

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SECTION 16050 (260500) – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:
 - 1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
 - 2. Sleeves and seals for electrical penetrations.
 - 3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 - 4. Sealing penetrations through noise critical spaces.

1.2 DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these Specifications:
 - 1. AHJ: Authority(ies) having Jurisdiction
 - 2. ATS: Acceptance Testing Specifications
 - 3. EPDM: Ethylene-propylene-diene monomer rubber
 - 4. MC: Metal Clad
 - 5. NBR: Acrylonitrile-butadiene rubber
 - 6. NRTL: Nationally Recognized Testing Laboratory
 - 7. PCF: Pounds per Cubic Foot
- B. The following definitions apply to this and other Sections of these Specifications:
 - 1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
 - 4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
1. Product data for the following products:
 - a. Sleeve seals.
 - b. Through and membrane penetration firestopping systems.
 - c. Joint sealers
 2. Shop drawings for:
 - a. Detailed fabrication drawings of access panels and doors.
 3. Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to qualified testing and inspecting agency’s illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer’s fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
 - b. Qualifications data for testing agency.
 4. Record Drawings: Submit Record Drawings as required by Division 1 and Division 26
 - a. Accurately record actual locations of firestopped penetrations and access panel/door locations. Indicate dimensions from fixed structural elements.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 ACCESS TO EQUIPMENT

- A.]Manufacturers:
1. Bar-Co., Inc.
 2. Elmdor Stoneman.
 3. JL Industries
 4. Jay R. Smith Mfg. Co.
 5. Karp Associates, Inc.
 6. Milcor
 7. Nystrom Building Products
 8. Wade
 9. Zurn
- B. Access Doors:
1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Electrical Systems” for labeling of access doors.

2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
8. Locking Devices: Flush, screwdriver-operated cam locks.

2.3 SLEEVES

- A. Steel sleeves for raceways and cables
 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends and drip rings.
- B. Cast iron wall pipe sleeves for raceways and cables
 1. Manufacturers
 - a. Josam Mfg. Co.
 - b. Smith (Jay R) Mfg. Co.
 - c. Tyler Pipe/Wade Div.; Subs of Tyler Corp.
 - d. Watts Industries, Inc.
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 2. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.
 3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138- inch thickness as indicated and of length to suit application.
 4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

2.4 SEALANTS

- A. SLEEVE SEALS
 1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 2. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. O-Z/Gedney
 - e. Pipeline Seal and Insulator, Inc.
 3. Sealing Elements: Interlocking or solid sealing links shaped or pre-drilled to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.
 - a. EPDM

- b. NBR
- c. Neoprene
- 4. Pressure Plates: Include two for each sealing element. For multi-phase circuits, use slotted pressure plates if metal.
 - a. Plastic
 - b. Carbon steel
 - c. Stainless steel
 - d. PVC-coated steel
- 5. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements. Include one for each sealing element.
 - a. Carbon steel with corrosion-resistant coating
 - b. Stainless steel

B. JOINT SEALERS

- 1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- 2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.
- 3. Elastomeric Joint Sealers: Provide the following types:
 - a. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - b. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - c. Products: Subject to compliance with requirements, provide one of the following:
 - 1) One-Part, Nonacid-Curing, Silicone Sealant:
 - a) "Dow Corning 790," Dow Corning Corp.
 - b) "Dow Corning 795," Dow Corning Corp.
 - c) "Silglaze N SCS 2801," General Electric Co.
 - d) "Silpruf SCS 2000," General Electric Co.
 - e) "864," Pecora Corp.
 - f) ".Omniseal," Sonneborn Building Products Div
 - g) "Spectrem 1," Tremco, Inc.
 - h) "Spectrem 2," Tremco, Inc.
 - 2) One-Part, Mildew-Resistant, Silicone Sealant:
 - a) "Dow Corning 786," Dow Corning Corp.
 - b) "Sanitary 1700," General Electric Co.
 - c) "898 Silicone Sanitary Sealant," Pecora Corp.
 - d) "OmniPlus," Sonneborn Building Products Div.
 - e) "Tremsil 600 White," Tremco Corp.
- 4. Acrylic-Emulsion Sealants: One-part, non-sagging, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) "Chem-Calk 600," Bostik
 - 2) "AC-20," Pecora Corp.
 - 3) "Sonolac," Sonneborn Building Products Div.
 - 4) "Tremflex 834," Tremco, Inc.

C. FIRESTOPPING

- 1. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, by Underwriters' Laboratories, Inc., or other NRTL acceptable to AHJ.

- a.]Manufacturers:
 - 1) Hilti, Inc.
 - 2) RectorSeal.
 - 3) Specified Technologies Inc.
 - 4) 3M Corp.
 - 5) United States Gypsum Company.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- C. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)
- D. Comply with NECA 1.
- E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.
- F. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- G. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- H. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.2 ACCESS DOORS

- A. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.
- C. Label all access doors with a nameplate as described in Division 26 Section "Identification for Electrical Systems".

3.3 SLEEVES AND SLEEVE SEALS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.
- C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.

- D. New Construction:
 - 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support raceway penetrations.
- E. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.
- F. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- G. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- H. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- I. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.
- J. Cut sleeves to length for mounting flush with both surfaces of walls.
- K. Extend sleeves installed in floors 2 inches above finished floor level.
- L. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed; in which case, size sleeves as recommended by the seal manufacturer.
- M. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- N. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint
- O. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- P. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- Q. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- R. Above Grade Concrete or Masonry Penetrations
 - 1. Provide sleeves for cables or raceways passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.

- c. Install galvanized sheet metal for rectangular sleeves
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
- 2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½” of sealant.
- S. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. Provide mechanical sleeve seal.
 - 1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - 2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.
- T. Elevated Floor Penetrations of waterproof membrane:
 - 1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum ½” annular space between wall pipe and cable or raceway.
 - 2. Pack with mineral wool and seal both ends with minimum of ½” of waterproof sealant.
 - 3. Secure waterproof membrane flashing between clamping flange and clamping ring.
 - 4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- U. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.
- V. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½” of sealant.
- W. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½” of waterproof sealant.
- X. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- Y. Sleeve-Seal Installation
 - 1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
 - 2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Z. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.5 JOINT SEALERS

A. Preparation for Joint Sealers

1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.
2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

B. Application of Joint Sealers

1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical raceways penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.6 ACOUSTICAL PENETRATIONS

A. Do not allow direct contact of raceways with shaft walls, floor slabs and/or partitions. Sleeve, pack and seal airtight with foam rod, non-hardening sealant and/or packing material, as described herein, for all penetrations by raceway, through surfaces that encompass or are between noise critical spaces. Seal and pack with caulking for the full depth of the penetration all openings around raceways in the structure surrounding the electrical equipment and surrounding noise-critical spaces. This includes all slab penetrations and penetrations of noise critical walls.

B. Where a raceway passes through a wall, ceiling or floor slab of a noise critical space, cast or grout a metal sleeve into the structure. The internal diameter or dimensions of the sleeve shall be 2 inches larger than the external diameter or dimensions of the raceway passing through it. After all of the raceways are installed in that area, check the clearances and correct, if necessary, to within 1/2-inch. Pack the voids full depth with packing material sealed at both ends, 1-inch deep, with non-hardening sealant backed by foam rod.

END OF SECTION

SECTION 16180 (260502) - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and rough-in requirements based on shop drawings.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products for:
 - 1. Special connectors
 - 2. Special conductors or cable assemblies.
- C. Shop drawings for:
 - 3. Detailing electrical characteristics, wiring diagrams, fabrication and installation for wiring systems.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 - 4. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.
 - 5. Marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 CORDS AND CAPS

- A. Attachment Plugs: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.
- C. Cord: See Paragraph "Flexible Cords" in Division 26 Section "Low-voltage Electrical Power Conductors and Cables".
- D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

1.2 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.
- C. Provide fire-resistive protective assembly or an electrical circuit protective system for feeders and control circuit conductors and cables having a fire-resistance rating of not less than 2 hours where required by NFPA or local building codes. Types of systems requiring a fire-resistive protective assembly include, but are not limited to:
 - 1. Feeders for Emergency Power systems
 - 2. Smokeproof Enclosure Pressurization systems
 - 3. Smoke Removal systems
 - 4. Fire service and Occupant Evacuation Elevator systems

3.2 ELECTRICAL DEVICES

- A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) as indicated, specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.3 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturers' instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.

- C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated on the Drawings.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.4 EQUIPMENT

- A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.
- D. Motorized Damper: Provide lockable toggle, pilot lighted disconnect switch in an accessible location at each motor actuator, or group of motor actuators.

3.5 DOOR OPERATORS AND HARDWARE

- A. Provide electrical connections to automatic entry doors, automatic corridor doors, electrically held door latches, remote release doors, and all other required electrical connections for door systems included in other sections of these specifications.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control wiring and conduit for all equipment that is not included within the responsibility of the door hardware installer. Provide connection from junction boxes to the door operators or hardware and from door operators to actuation devices as required. Install key operated switches, push pad switches, and other electrically controlled door operation devices furnished by other divisions within this contract.
- D. Provide fire alarm devices and wiring as required for proper operation of door systems in accordance with the NFPA codes.

END OF SECTION

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SECTION 16421 (260504) - PROVISIONS FOR ELECTRIC UTILITY SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions for Underground Secondary Electrical Service.

1.2 GENERAL REQUIREMENTS

- A. Utility service voltage:
 - 1. [As indicated on the Drawings.]
- B. Utility service ampacity: As indicated on the Drawings.
- C. The extent of Work for the secondary electrical service includes providing the following:
 - 1. Raceways
 - 2. Provisions for Metering
 - 3. Grounding and Bonding
 - 4. [Concrete pad for service transformer]
 - 5. [Service lateral]
 - 6. [Service drop]
 - 7. [Primary raceways]

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Product data for the following products for:
 - a. Meter bases
 - b. Current transformer cabinets
 - 2. Shop drawings for:
 - a. Utility Company prepared installation drawings
 - b. Cast-in-place concrete pads
- B. Where equipment or materials are specified to comply with utility standards and are listed above as required submittals, obtain approval from the serving utility before submitting to the Contract Administrator.
- C. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Accurately record actual routing of interior conduits two-inch and larger trade size and all exterior buried raceway, including coordination with other surrounding utilities and underground structures. Provide scaled plans and sections that Indicate dimensions from finished grade or other fixed structural elements.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with Utility Company installation drawings and service standards.
- B. Maintain one copy of Utility Company installation drawings and service standards at the site.

- C. Prior to commencing work in this Section, meet with the Utility Company representative to review service entrance requirements and details.
- D. Verify that field measurements are as indicated on Utility Company drawings.
- E. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- F. Comply with NFPA 70.

PART 2 - EXECUTION

2.1 SECONDARY SERVICE ENTRANCE UNDERGROUND

- A. Provide an underground secondary service lateral from the pad mounted transformer in accordance with NFPA 70 Article 230 and the Utility Company standards. Reference the Drawings for service lateral conductor and raceway quantities, sizes, and types.
- B. The Utility Company will provide the service transformer.
- C. Provide a concrete pad, complying with the Utility Company standards, for transformer mounting, and set coated GRS conduit elbows and riser(s), with grounding bushing(s), to receive primary and secondary raceways. Where direct burial primary is used, set coated GRS conduit elbow(s) and riser(s), with grounding bushing(s), to receive primary cables.
- D. Make connections to the secondary terminals of the transformer as required and in conformance with Utility Company requirements. Utility Company will provide primary conductors and terminal connections unless otherwise directed by the Utility Company.
- E. Provide underground raceways for primary cables from the transformer pad to the property line, and provide pull cord, per Utility Company standards, for the Utility Company's use in pulling primary conductors. Install raceways a minimum of 24 inches below finished grade line unless otherwise indicated on the Drawings or directed by the Utility Company. Provide excavation and backfill as required to accomplish the installation.

2.2 METERING

- A. [Provide a 1-1/4-inch empty GRS conduit, with pull cord, from the current transformer compartment of service entrance equipment to the meter location indicated on the Drawings, or as directed by the Utility Company.]
- B. The Utility Company will provide the meter and meter wiring.

2.3 UTILITY SERVICE CHARGES

- A. It shall be the responsibility of the Division 26 contractor to apply for the electrical service, including the preparation and completion of all forms. Submit the completed application along with all other required documentation for the new or modified service.
- B. The Owner will pay all charges of the Utility Company for the electrical service.

END OF SECTION

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SECTION 16426 (260510) – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes general construction materials and methods, communications equipment coordination, and common communications installation requirements as follows:
 - 1. Pathways for Communications Systems
 - a. Conduits and Backboxes
 - b. Floor Boxes and Poke Throughs
 - c. Cable Trays
 - d. Access doors
 - e. Fire Stop System Assemblies for Communications Systems
 - f. Sleeves entering noise critical spaces
 - 2. Telecommunications Backboards
 - 3. Grounding and Bonding for Communications Systems

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING

- A. Division 07 Section “Penetration Firestopping” for fire stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section “Common Work Results for Electrical” for electrical systems coordination.
- C. Division 26 Section “Grounding and Bonding for Electrical Systems” for electrical systems coordination.
- D. Division 26 Section “Hangers and Supports for Electrical Systems” for electrical systems coordination.
- E. Division 26 Section “Raceways and Boxes for Electrical System” for electrical systems coordination.
- F. Division 26 Section “Cable Tray” electrical systems coordination.
- G. Division 26 Section “Underfloor Raceways for Electrical Systems” electrical systems coordination.
- H. Division 26 Section “Underground Ducts and Raceways for Electrical Systems” for electrical systems coordination.
- I. Division 26 Section “Seismic Controls for Electrical”.
- J. Division 26 Section “Vibration and Seismic Controls for Electrical Systems” for electrical systems coordination.

1.3 CODES, REFERENCES, AND STANDARDS

- A. Follow all applicable codes, references, and standards listed in Division 26 Section “General Electrical Requirements”.
- B. The references to the following standards and guidelines represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the correct revision or printing (UON).

1. TIA-569 – “Telecommunications Pathways and Spaces”
2. TIA-607B – “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”
3. ANSI/NECA/BICSI 607-2011 – Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
4. BICSI Telecommunications Distribution Methods Manual (TDMM)
 1. NEMA VE 1-1998 – “Metallic Cable Tray Systems”
 2. NEMA VE 2-2000 – “Cable Tray Installation Guidelines”
 3. ASTM E 814 and ANSI/UL1479 – “Fire Tests Through Penetration Firestops”
5. Telecommunications Service Provider Pathway Requirements

1.4 QUALITY ASSURANCE

- A. Personnel Qualifications: All pathways shall be reviewed prior to submittal of shop drawings and installation, as well as during construction, by a Registered Communications Distribution Designer (RCDD) for conformance to referenced codes, standards and guidelines.
 1. Any deficiencies encountered prior to and during installation shall be corrected under the direction of this RCDD by the installing contractor.
- B. All cable supports shall be manufactured by a company which produces cable supports. No field made apparatus will be accepted without prior written approval.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 1. Personnel Qualification – submit copy of RCDD’s certificate
 2. Product data for the following products:
 - a. Floor Boxes and Poke Throughs
 - b. Cable Trays
 - c. Fire Stop Materials and Systems
 - 1) At a minimum firestop cut-sheets shall provide the following information for each system to be installed:
 - a) Documentation from UL catalog for each system proposed. This documentation shall include the following information:
 - i) Firestop manufacturer
 - ii) UL system number
 - iii) F, T, and L Ratings
 - iv) The complete description of the firestop system; To include what specific construction the system is intended to pass through such as a wall or floor assembly, the penetrating items allowed to pass through the opening in the wall or floor assembly, and the materials designed to prevent the spread of fire through the openings.
 - d. Telecommunications ground bars and connectors
 3. Shop Drawings for:
 - a. Submit for review scaled layout drawings showing the routing of all pathways and firestop locations (with quantity and NRTL system number identified), Each pathway shall be identified by type and size on the drawings.
 - b. Unless otherwise required by these specifications, it is permissible to show different pathways systems (conduit, cable tray, auxiliary supports, etc.) on the same shop drawing.
 4. Record Documents:
 - a. Resubmittal of approved product submittals, with installation and O&M manuals.
 - b. Floor plans shall show the routing of all pathways and firestop locations (with quantity and NRTL system number identified) as actually installed. Each pathway shall be identified by type and size on the drawings.

- c. Letter stating that the Telecommunications Grounding and Bonding System has been installed in accordance with the referenced standards and contract documents, including testing requirements.

1.6 DEFINITIONS

- A. Bonding Conductor for Telecommunications (BCT) – the conductor that bonds the TMGB to the service equipment (power) ground.
- B. Communications Room - means the location of a floor-serving facility for housing telecommunication equipment, and potentially other low-voltage systems such as audio-visual, security and fire alarm (electronic safety and security) equipment. Also known as Telecommunications Room, Telecom Room, IT Room, MDF, or IDF.
- C. IDF – Intermediate Distribution Frame, secondary Communications Room(s) for a building
- D. IMC – Intermediate Metal Conduit
- E. MDF – Main Distribution Frame, the Main Communications Room for a building
- F. Point of Entrance (Building Entrance) – The point within a building where the Outside Plant (OSP) communications cabling emerges from an external wall, a concrete floor slab, or IMC/RMC. If Communications Point of Entrance isn't identified on the drawings, assume the Main Communications Room (MDF) also acts as the Point of Entrance.
- G. RCDD – Registered Communications Distribution Designer as certified by BICSI
- H. RMC – Rigid Metal Conduit
- I. STC – Sound Transmission Class, a single number decibel rating of the transmission loss properties of an assembly. Measured transmission loss data is plotted versus frequency and compared with standard contours according to rules outlined in ASTM E 90 and ASTM E 413.
- J. Telecommunications Bonding Backbone (TBB) – A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB).
- K. Telecommunications Grounding Busbar (TGB) – A common point of connection for telecommunications system and equipment bonding to ground, and located in the telecommunications room or space.
- L. Telecommunications Main Grounding Busbar (TMGB) – A busbar placed in a convenient and accessible location in the MDF and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment with Telecommunications equipment furnished by Owner and Telecommunications service providers.
- B. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.
 - 3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.
- E. Coordinate testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.8 NOISE CRITICAL SPACES

- A. For Noise –critical spaces, provide Acoustic Pathway Devices as needed and attenuating measures and acoustical sealants as indicated in Division 26, “ Common Work Results for Electrical”.

PART 2 - PARTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 PATHWAYS FOR COMMUNICATIONS SYSTEMS

- A. Raceways and Boxes for Communications Systems
 - 1. General Requirements
 - a. Refer to Division 26, “Raceways and Boxes for Electrical Systems” for Available Manufacturers and other specific product, material and installation requirements.
 - b. Outlet boxes located in plenum accessible ceiling space shall be listed for installation in a plenum.
 - c. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers models that meet the specified criteria.
 - 2. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in stud walls:
 - a. Requirements:
 - 1) Minimum size of 4-11/16 inches (119.1 mm) width by 4-11/16 inches (119.1 mm) height by 2-1/8 inches (54 mm) depth
 - 2) with a single-gang raised cover/extension ring a minimum of 3/8” deep. Depth shall match that of wall gypsum board(s)
 - b. Manufacturer shall be:
 - 1) Appleton 4SJD-1 series with single gang extension ring
 - 2) RACO 258/259 series with single gang extension ring
 - 3) Randl T-55017 with single gang extension ring

3. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in masonry construction:
 - a. Requirements:
 - 1) Minimum size shall be single gang, a minimum of 3-1/2 inches deep.
 - b. Manufacturer shall be:
 - 1) Single gang
 - a) RACO 695/8695 or equivalent
 - b) Appleton MI-250 series or MI-350 series.
 - c) RACO 690 series or 695 series.
 - d) Steel City GW series.
4. Back boxes for Audio Visual outlets
 - a. Refer to AV drawings and specifications for exact requirements. When there are no AV drawings/specifications, meet the requirements of this section:
 - b. Requirements
 - 1) Dual-gang
 - 2) Depth shall be 3-1/2 inches.
 - c. Manufacturer shall be:
 - 1) Extron JB series (3.5" deep)
 - 2) Or equivalent from Available Manufacturers
 - 3) Or Approved Equivalent
5. Pull Boxes
 - a. Specifications
 - 1) Refer to drawings for sizing requirements.
 - 2) Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - 3) Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
 - b. The following manufacturers are Conditionally Approved.
 - 1) Hoffman
 - 2) Refer to Manufacturers in Boxes, Enclosures and Cabinets section of Division 26 "Raceways and Boxes for Electrical Systems".

B. Floor Boxes

1. General:
 - a. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the tables below. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Manufacturers listed above and models that meet the specified criteria.
 - b. Floor boxes used for power: Include a minimum of one normal 20A, 125V NEMA 5-20R duplex receptacle unless noted or scheduled otherwise on the Drawings. Wiring device color: Refer to Division 26 Section "Wiring Devices", or as indicated on the Drawings.
 - c. Floor boxes utilized for communications: Include provisions for mounting communications faceplate and connectors in accordance with the requirements of the communications systems provider.
 - d. Telecommunications pathways back to serving Communications Room – See detail on drawings for pathway requirements.
2. **Floor-mounted Telecommunications Outlet (Telephone and/or Data connections only):** For slab on grade: watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Shallow slab-on-grade depths necessitate use of Box Type E. Shallow above-grade slabs necessitate use of Poke-Through Outlet. Conduits shown on plans are minimum size; select appropriate floorbox based on slab type, thickness, and minimum conduit size.

<u>MFR</u>	<u>CAST IRON</u> <u>BOX</u>	<u>STAMPED</u> <u>STEEL BOX</u>	<u>COVER</u> <u>PLATE</u>	<u>CARPE</u> <u>T TRIM</u>	<u>Coordination</u>
Steel City	600 2SC(accepts up to (4) 2" conduits)	68 D (accepts up to (4) 1" conduits)	P60-DS or P60-1/2-2 for Furniture Feeds	P60-CP	Coordinate with Owner/Telecommunications installer – requires that they install Duplex Insert for floor outlets.
Wiremold	889B (accepts up to (2) 1-1/4" conduits)	886B (only accepts (1) 1" conduit)	895GFI (Carpet) / 895TGFI (Tile) or 896CK (Carpet) / 896TCK-1 (Tile) for Furniture Feed	n/a	Coordinate with Owner/Telecommunications installer – requires that they install Decora Insert for floor outlets
Hubbell	For 4" slabs – B253641 (accepts up to (4) 1" conduits) For 4.75+" slabs, B2506 (accepts up to (4) 1-1/4" conduits)	For 4" slabs only – B2527 (accepts up to (1) 1-1/4" conduit and (1) 1" conduit)	S3925 or S2725 for Furniture Feed	S3182	Coordinate with Owner/Telecommunications installer – requires that they install Duplex Insert for floor outlets.

3. **Box Type E - Multi-Service (2 compartment):** For slab on grade: watertight, Class 1, fully adjustable, cast iron. For slab above grade: concrete-tight, Class 2, fully adjustable, stamped galvanized steel. Two compartments - one side plate with knockouts for communications faceplate and connectors; one side plate with provisions for one duplex receptacle. Furnish polycarbonate or nylon cover and flange piece with standard color as directed by Architect. Conduits shown on plans are minimum size; select appropriate floorbox based on slab type, thickness, and minimum conduit size. Shallow above-grade slabs necessitate use of Poke-Through Outlet.

<u>MFR</u>	<u>CAST IRON</u> <u>BOX</u>	<u>STAMPED</u> <u>STEEL BOX</u>	<u>RECEP</u> <u>TACLE</u> <u>PLATE</u>	<u>BLANK PLATE</u>	<u>COVER</u>
Steel City	664-CI (accepts (3) 1" conduits in Communications compartment)	664	664-RP, 664-GP (Decorat or Style)	664-BP	664-CST Series
Wiremold	RFB2-OG	RFB2-SS	RFB2DP , RFB2B (Decorat or Style)	RFB2B	FP Series
Hubbell	3SFBC (accepts (1) 1-1/4" conduit in Communications compartment)	3SFBSS (accepts (1) 1" conduit in Communications compartment)	3SFBRP , 3SFBDS (Decorat or Style)	3SFBB	3SFBCxxA Series

4. **Box Type F / AV - Multi-Service (3 or 4 compartment):**

- a. Refer to Audio/Video drawings and specifications for exact floorbox requirements. If there are no AV drawings and specifications, then the following requirements apply:
- 1) For slab on grade: watertight, Class 1, fully adjustable, cast iron, unless otherwise noted. For slab above grade: concrete-tight, Class 2, fully adjustable, stamped galvanized steel.
 - 2) Three to four compartments, 3-1/2-inch maximum overall depth, and provisions for power receptacles and communications faceplate and connectors. Furnish hinged cover and nylon or polycarbonate flanged trim with standard color as directed by Architect.
 - 3) Conduits shown on plans are minimum size; select appropriate floorbox based on slab type, thickness, and minimum conduit size.

<u>MFR</u>	<u>SLAB-ON- GRADE BOX</u>	<u>STAMPED STEEL BOX</u>	<u>ELECTRICAL RECEPTACLE PLATE</u>	<u>BLANK PLATE</u>	<u>COVER</u>
FSR	FL-500P-3" (accepts up to (4) 1-1/4" conduits) with Pour Pan (concrete-tight, acceptable only when used with Pour Pan)	FL-500P-3" (accepts up to (4) 1-1/4" conduits)	FL-P3"- DECORA	FL-P3"	FL-500P Series
Steel City	665-CI	665	665-RP, 665- GP (Decorator Style)	665-BP	665-CST Series
Wiremol d	RFB4-CI	RFB4	RFB-DR, RFB- GFI (Decorator Style)	RFB-B	FP Series
Hubbell	HBLCFB401C B	HBLCFB30 1BASE	HBLST302SGY , HBLDE301SG Y (Decorator Style)	HBLBL300SGY	HBLTCGNT Series

5. **Box Type G - Access Floor Small Service Module:** Nominal 8-inch x 8-inch drop-in service module for installation in raised access floors. Galvanized steel or cast aluminum construction, hinged outer cover with flip-lid for cable egress, and nylon or polycarbonate trim with standard color as directed by Architect. Minimum of two (2) compartments with provisions for power receptacles and communications faceplate and connectors as scheduled or noted on the Drawings.

<u>MFR</u>	<u>BOX AND COVER</u>	<u>RECEPTACLE PLATE</u>	<u>BLANK PLATE</u>
Steel City	AFM-4	AFP-4A, AFP-4GFCI (Decorator Style)	AFP-4B
Wiremold	AF1	SGT-DP	SGT-B
Hubbell	HBLAFB401 (Base)/ HBLTCGNT (Cover)	ST302, DE301 (Decorator Style)	BL300

6. **Box Type H / AV - Access Floor Large Service Module:**

- a. Refer to Audio/Video drawings and specifications for exact floorbox requirements. If there are no AV drawings and specifications, then the following requirements apply:
- 1) Nominal 8-inch x 10-inch drop-in service module for installation in raised access floors. Galvanized steel or cast aluminum construction, hinged outer cover with flip-lid for cable egress, and nylon or polycarbonate trim with standard color as directed by Architect. Minimum of two (2) compartments with provisions for power receptacles and communications faceplate and connectors as scheduled or noted on the Drawings.

<u>MFR</u>	<u>BOX AND COVER</u>	<u>ELECTRICAL RECEPTACLE PLATES</u>	<u>BLANK PLATE</u>
FSR	FL-540P-4" (accepts up to (4) 1-1/2" conduits)	Standard 1-gang or 2-gang decora wall plate	Standard 2-gang, 3-gang and/or 4-gang blank plates to cover remaining openings.
Steel City	AFM-6	AFP-6A, AFP-6Q, AFP-6GFCI (Decorator Style)	AFP-6B
Walker	AF3	SGT-DP, SGB-DP	SGT-B, SGB-B
Hubbell	AFB301 (Base)/HBLTCGN T (Cover)	HPWST302SGY, HPWDE301SGY (Decorator Style)	HPWBL300SGY

C. Poke-Through Outlets (Multi-Service)

1. General
 - a. UL listed and UL Fire Classified, flush type, with one- to four-hour fire rating, as required by floor rating and type.
 - b. Telecommunications pathways back to serving Communications Room – See detail on drawings for pathway requirements.
2. Type A – Flush: Dual Service for Power and Telecommunications only, with outlets flush in the floor
 - a. Capable of supporting, at a minimum, a duplex 20A/125V receptacle (or equivalent), and one decora style opening / mounting plate for telecommunications.
 - b. Coordinate cover type and color with Architect.
 - c. Manufacturer shall be:
 - 1) Wiremold 6ATC Series with 6DEC Mounting Plate.
 - 2) Hubbell S1PT Series
3. Type B – Furniture Feed: Dual Service for Power and Telecommunications only, with cables to extend through flexible conduit into modular furniture.
 - a. Poke Thru and cover plate shall support 3/4" trade size screw plug opening for electrical and 1-1/4" trade size screw plug opening for telecommunications.
 - b. Coordinate cover finish with Architect.
 - c. Manufacturer shall be:
 - 1) Wiremold 6ATCFF Series
 - 2) Hubbell S1PTFF Series
4. Type C – Flush (with AV): Multiple Service for Power, Telecommunications, and AV
 - a. Capable of supporting, at a minimum, a duplex 20A/125V receptacle (or equivalent), pre-wired to a junction box, and one decora style opening / mounting plate for telecommunications.
 - b. Coordinate cover type and color with Architect.
 - c. Manufacturer shall be:
 - 1) Wiremold 8ATC Series with (2) 68REC-25 Duplex Receptacles for power and (1) 8DEC Mounting Plate for telecommunications. Coordinate with Owner / AV installer for other required inserts; if direction is not given in a timely manner, provide blank inserts for remaining of openings.

- 2) FSR SmartFit 8” Series with (2) SF8-SPO3 Duplex Receptacles for power and (1) SF8-SPC4 decora style opening / mounting plate for telecommunication. Coordinate with Owner / AV installer for other required inserts; if direction is not given in a timely manner, provide blank inserts for remaining of openings.

D. Cable Tray

1. Flexible cable tray
 - a. Manufacturers:
 - 1) Chatsworth
 - 2) Cooper B-Line
 - 3) Hoffman
 - 4) Legrand/Cablofil
 - 5) MPHusky
 - 6) Schneider Electric/WIBE
 - 7) Snake Tray
 - 8) Thomas & Betts
 - 9) WBT LLC
 - b. Specifications
 - 1) Cable Tray Size: Size identified on drawings indicate minimum width and depth size. Provide cable tray of sufficient size to accommodate a maximum calculated fill ratio of 50% for all Division 27 and 28 cabling, to include all cables installed plus 25% growth.
 - 2) Cable tray systems shall be pre-fabricated structures for supporting and routing cables or conductors that are pulled or laid in place after the pathway has been installed as a complete system.
 - 3) Flexible cable tray systems shall consist of straight sections, fittings, and accessories as necessary for a complete, continuously grounded system.
 - 4) Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire basket sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
 - 5) Cable Tray Materials: Steel rod and/or wire; corrosion resistant to the degree suitable for the environment where it is to be installed; field-bendable.
 - 6) Cable Tray Types:
 - a) Wire cable tray: a cable tray manufactured from metal wire welded at all intersections and is formed to provide a channel for the cables.
2. Rigid Cable Tray
 - a. Manufacturers:
 - 1) Chatsworth
 - 2) Cooper B-Line
 - 3) Hoffman
 - 4) Legrand/Cablofil
 - 5) MPHusky
 - 6) Schneider Electric/WIBE
 - 7) Thomas & Betts
 - 8) WBT LLC
 - b. Specifications
 - 1) Refer to Electrical Division 26 for specific product and material information.
 - a) Sizes, methods, and more stringent requirements shall be adhered to when specified in this Division.
 - 2) Cable Tray Size: Provide cable tray with the loading depth and loading width as shown on the drawings.
 - 3) Cable tray systems shall be pre-fabricated structures for supporting and routing cables or conductors that are pulled or laid in place after the pathway has been installed as a complete system.

- 4) Cable trays shall be designed to accommodate a maximum calculated fill ratio of **50%**, to include all cables installed with **25%** growth.
- 5) Interior cable trays shall be striped, traced, colored, or marked with color in no less than **5 feet (1.5 m)** increments by permanent means using appropriate methods to assist in identifying its purpose to installers and the Owner in the future.
 - a) Methods such as spray painting conduits or sections of pathways are acceptable but shall be done prior to installation.
 - b) The support span for cable support systems shall be determined in accordance with the manufacturer's maximum recommended load capacity for a given span. These systems may be supported by three basic methods: cantilever brackets from a wall, trapeze or individual rod supports from the ceiling, or directly from the floor.
 - c) Cable tray supports shall be located where practicable so that connections between sections of the tray fall between the support point and $\frac{1}{4}$ the distance of the span. A support should be placed within **24 inches (609.6 mm)** on each side of any connection to a bend, tee, or cross. See the NEMA-VE2 Metal Cable Tray Installation Guidelines for additional cable tray support and installation recommendations.
- 6) Cable tray systems shall consist of straight sections, fittings, and accessories as defined in NEMA VE-1 and UL classified as equipment grounding conductors. Provide radiused elbows, tees, crosses, splice plates, wall and overhead supports, and other fittings necessary for a complete, continuously grounded system.
 - a) Fittings and connectors shall be used to connect straight sections and change direction or size. Fittings include horizontal bends, vertical bends, reducers, crosses and tees. Connectors may include splice plates, splice clamps, and tee clamps. Accessories may include such items as covers, conduit adapters and barriers.
- 7) Cable Tray Materials and Finishes:
 - a) Aluminum: Straight sections and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052. Splice plates shall be of wedge lock design, using four square neck carriage bolts and serrated flange locknuts
 - b) Pre-Galvanized Steel: Straight sections and fitting side rails, rungs and covers shall be made from steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90. Splice plates shall be manufactured from high strength steel, using ribbed carriage bolts and serrated flange locknuts
 - c) Hot Dipped Galvanized After Fabrication Steel: Straight sections, fitting side rails and rungs shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter, and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All covers and splice plates shall also be hot-dip galvanized after fabrication; mill galvanized covers are not acceptable for hot-dipped galvanized cable tray. All hot-dip galvanized after fabrication steel cable trays shall be returned to point of manufacture after coating for inspection and removal of all oxides and excess zinc. Failure to do so can cause damage to cables and/or injury to installers
 - d) Stainless Steel: Straight sections, fitting side rails and rungs shall be manufactured from AISI Type 304 or Type 316 stainless steel. Transverse members (rungs) or corrugated bottoms shall be welded to the side rails with Type 316 stainless steel welding wire
- 8) Rigid Cable Tray Types:
 - a) Ladder: Ladder type tray shall be a pre-fabricated structure consisting of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails, for supporting and routing cables or conductors within the structure. Rungs shall be spaced on [**6 inches (152.4 mm)**][**9 inches (228.6**

mm)][12 inches (304.8 mm)][18 inches (457.2 mm)] on center. Rung spacing in radiused fittings shall be 9 inches measured at the center of the trays width. Rungs shall have a minimum cable bearing surface of 3/4 inch (19.1 mm) with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails

- b) Ventilated-bottom or ventilated-trough cable tray: Ventilated trough type trays shall consist of three piece construction consisting of two longitudinal members (side rails) with a corrugated bottom welded to the side rails. The peaks of the corrugated bottom shall have a minimum flat cable bearing surface of 2-3/4 inches (69.9 mm) and shall be spaced 6 inches (152.4 mm) on center. To provide ventilation in the tray, the valleys of the corrugated bottom shall have 2-1/4 inch (57.2 mm) x 4 inch (101.6 mm) rectangular holes punched along the width of its bottom
- c) Solid-bottom or Solid Trough: Solid bottom trough type trays shall be of three piece construction consisting of two longitudinal members (side rails) with a solid corrugated bottom welded to the side rails. The peaks of the solid corrugated bottom shall have a minimum flat cable bearing surface of 2-3/4 inches (69.9 mm) and shall be spaced 6 inches (152.4 mm) on center.

3. Ladder Rack (inside Communications Rooms)

- a. Color: black
- b. UL Classified
- c. Provide ladder rack components such as inside radius bend, outside radius bend, and corner bracket for a complete system meeting drawings and manufacturer instructions.
- d. Provide ladder rack supports such as wall angle support kit, triangular support bracket, center support kit, threaded rod, I-beam clamp, threaded ceiling kit, cabinet elevation kit, foot kit, rack mounting plate, rack elevation kit for a complete system meeting drawings and manufacturer instructions.
- e. Provide ladder rack accessories such as cross member radius drop, end caps, and dividers for a complete system meeting drawings and manufacturer instructions.
- f. The following manufacturers are Conditionally Approved:
 - 1) Cooper B-Line
 - 2) Chatsworth
 - 3) Middle Atlantic

E. Access Doors for Communications Systems

- 1. Refer to Execution section for location requirements.
- 2. Refer to Division 26, "Common Work Results for Electrical" for specific product and material information.

F. Fire stop System Assemblies for Communications Systems

- 1. General
 - a. Communications cable tray shall not continue through a fire-rated wall. Stop the tray, install multiple Fire-Rated Pathway Devices for Communications (capacity shall match that of cable tray cross-sectional area), and continue tray on the other side. Ensure grounding of the tray is continuous through the wall.
 - b. Minimum performance requirements: Shall meet testing requirements of ASTM E-814 or U.L. 1479; Shall be installed in accordance with the NRTL. Provide fire stop systems appropriate for the specific application and in accordance with manufacturer's instructions.
 - c. Shall be a pre-fabricated and zero-maintenance solution which requires no action to activate the fire and smoke protective characteristics of the device.
- 2. Fire-Rated Pathway Device for Communications - for sleeves through a single penetration (wall or floor)
 - a. Allows the installation and removal of cables without the need to remove or add any materials.
 - b. Used to seal penetrations of cables through fire rated partitions.

- c. Manufacturer shall be:
 - 1) EZ-Path family of products by Specified Technologies Inc.
 - 2) Wiremold Flamestopper
 - 3) Or equivalent from Conditionally Approved manufacturer.
- 3. Through-Floor Firestopping Sleeve for Communications
 - a. Used to seal penetrations of cables through fire rated floor.
 - b. Manufacturer shall be:
 - 1) EZ-Path Series 44 - where (4) sleeves are shown together, provide grid system – STI EZG444
- 4. Firestopping for Communications Backboxes in Fire-Rated Walls
 - a. Specifications
 - 1) Used to seal communications backboxes in fire rated partitions.
 - 2) Minimum performance requirements: Shall meet UL testing requirements of UL 263 and classified as Wall Opening Protective Material (QCSN or CLIV); Shall be installed in accordance with the NRTL. Shall meet or exceed the ratings of the wall or floor that it is located in.
 - 3) Provide fire stop systems appropriate for the specific application and in accordance with manufacturer’s instructions.
 - b. Manufacturer shall be:
 - 1) Specified Technologies Inc., SpecSeal Power Shield
 - 2) Or equivalent from
 - a) 3M
 - b) Hilti
- 5. Firestopping for Thru-Wall (or Floor) Communications Conduit Penetrations and Other Applications
 - a. For fire-rated penetrations where the pathway extends beyond a single fire-rated partition/floor, and other required firestopping applications required by Communications Pathways not previously addressed in this specification.
 - b. Specifications:
 - 1) Shall be UL listed for the specific application;
 - 2) Shall meet or exceed the ratings of the wall or floor that it penetrates.
 - c. Manufacturer shall be:
 - 1) Specified Technologies Inc., SpecSeal Power Shield
 - 2) Or equivalent from
 - a) 3M
 - b) Hilti

G. Sleeves Entering Noise Critical Spaces – Acoustic Pathway Device

- 1. Where walls or ceiling-mounted Communications Devices are located inside Noise Critical Spaces, and/or for Communications System sleeves through acoustically-rated (non-fire-rated) walls at or above STC-50, provide Acoustic Pathway Device(s) to support low-voltage telecommunications/AV/security cabling.
- 2. Specifications:
 - a. Shall maintain STC Rating of the penetrated wall.
 - b. Shall accommodate cable loads from 0 to 100% visual fill.
 - c. Shall be zero-maintenance, meaning no action is required by cabling technician to open/close pathway for cable moves, adds, or changes.
 - d. Shall be engineered such that cables can
 - e. Where more than one Acoustic Pathway Device is needed, they shall be ganged together with manufacturer supplied grid.
- 3. Manufacturer shall be:
 - a. Specified Technologies EZ-Path Smoke & Acoustical Pathway (NEZ33)

2.3 TELECOMMUNICATIONS BACKBOARD

A. Telecommunications Backboard

1. A minimum of one wall shall be covered with **0.75 in (19 mm)** plywood, UON on drawings.
2. The backboard shall be 4 ft (1.2 m) x 8ft (2.4 m) sheets, mounted vertically, with the bottom of the plywood mounted **6 in (150 mm)** above the finished floor with the best side toward the room.
3. Plywood shall be A/C grade and finished with two coats of fire-retardant paint.
4. Plywood shall be painted prior to installation of any equipment; mask out one stamp on each sheet of plywood prior to painting.
5. Plywood shall be permanently fastened to the wall by means of wall anchors utilizing galvanized, zinc plated, or stainless steel hardware with a flat head. Finished installation shall have flush appearance with countersunk screw heads to prevent splitting of the plywood. Drywall screws are not acceptable.

2.4 GROUNDING AND BONDING FOR TELECOMMUNICATIONS SYSTEM

A. General

1. Provide a Telecommunications Grounding and Bonding System in accordance with the TIA 607B Standard and these construction documents. Where these differ, the more stringent requirement applies.
2. Component Manufacturers:
 - a. Chatsworth
 - b. Cooper B-Line
 - c. Erico
 - d. Harger
 - e. Hoffman
 - f. Panduit
3. Conductor Manufacturers
 - a. Shall be from the list of Component Manufacturers; or
 - b. Shall be from the list of Manufacturers in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

B. Telecommunications Main Ground Bar (TMGB)

1. Specifications
 - a. All busbars shall have a clear cover installed to protect connections
 - b. Cover shall be:
 - 1) Plexiglass or plastic
 - 2) Cover shall be printed with 1" lettering "TMGB" (or "TGB") using appropriate labels.
 - 3) Of the same manufacturer as the ground bar
 - c. A predrilled Electroplated copper busbar provided with holes for use with standard sized lugs
 - d. Have minimum dimensions of **1/4 inch (6.4 mm)** thick x **4 inches (101.6 mm)** wide x **20 inches (508 mm)** long.
 - e. Provide enough length for all connections with 25% growth.
 - f. Provided with insulators to electrically isolate busbar from mounting surface.
 - g. Provided with a minimum of **2-inches (50.8 mm)** clearance from wall or other mounting surfaces for access.
2. Manufacturer shall be
 - a. Harger TGBI144(**)TMGB
 - b. Chatsworth 40158-20
 - c. Or equivalent from Component Manufacturer

C. Telecommunications Ground Bar (TGB)

1. Specifications
 - a. Be a predrilled Electroplated copper busbar provided with holes for use with standard sized lugs

- b. Have minimum dimensions of 1/4 inch (6.4 mm) thick x 4 inches (101.6 mm) wide x 12 inches (304.8 mm) long
 - 1) Provide enough length for all connections with 25% growth
 - c. Provided with insulators to electrically isolate busbar from mounting surface
 - d. Provided with a minimum of 2-inches (50.8 mm) clearance from wall or other mounting surfaces for access.
 - 2. Manufacturer shall be
 - a. Harger TGBI142(**)TGB
 - b. Chatsworth # 40156-012
 - c. Or equivalent from Component Manufacturer
 - D. Ground Wire for TBB
 - 1. Specifications
 - a. All grounding and bonding connectors shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as required by the NEC.
 - b. All grounding and bonding conductors shall be copper and may be insulated UON. When conductors are insulated, they shall be listed for the application (i.e. Plenum, riser, outside plant, etc.)
 - c. Ground Wire for TBB: Non-Insulated grounding wire with a minimum conductor size as indicated on drawings. Wire Shall be UL listed.
 - d. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name.
 - 2) Copper Conductor Gauge.
 - 3) UL listing.
 - e. Cable jacket shall be green with black lettering.
- E. Bonding Conductor (To main Electrical service ground) for Telecommunications (BCT): Insulated grounding wire with a minimum copper conductor size equal to that of the TBB, with PVC insulation. Shall be UL listed.
 - 1. Specifications
 - a. Insulated grounding wire with PVC insulation
 - b. A minimum copper conductor size equal to that of the largest TBB or other bonding conductor connected to the TMGB, UON.
 - c. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name
 - 2) Copper Conductor Gauge
 - 3) NRTL listing information
 - d. Cable jacket shall be green with black lettering
 - e. A minimum conductor size as indicated on drawings
- F. Ground Wire (for connections within each Telecommunications Room and to Cable Tray)
 - 1. Specifications
 - a. When *not* routed through plenum or other air-handling space: Insulated grounding wire with a minimum copper conductor size of number 6 AWG, with PVC insulation. Shall be UL listed.
 - b. When routed through plenum or other air-handling space: *Non-Insulated* grounding wire with a minimum copper conductor size of number 6 AWG. Shall be UL listed.
 - c. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name.
 - 2) Copper Conductor Gauge.
 - 3) UL listing.
 - d. Cable jacket shall be green with black lettering.
- G. Connectors
 - 1. Specifications

- a. All connections between cables and the joining or mating of cables to connectors shall be done by exothermic weld or irreversible compression connector.
- b. Connector Terminal: Heavy duty, high copper alloy terminal for joining cable to grounding bus bar.
- c. Twin clamping elements for cable; two holes for attachment to grounding bar, etc
- 2. Connector Terminal
 - a. Specifications
 - 1) Medium duty, high copper alloy terminal for joining cable to equipment racks, cable racking and cable tray.
 - 2) Twin clamping elements for cable; one (or more) holes for attachment to rack, tray, etc.
 - b. Manufacturer:
 - 1) Submit product data from Connector Manufacturer
- 3. Cable to cable connector
 - a. Specifications
 - 1) Heavy duty, permanent connection between two or more copper conductors; splice “T” or cross, as indicated on the drawings and as required.
 - b. Manufacturer:
 - 1) Submit product data from Connector Manufacturer

PART 3 - EXECUTION

3.1 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. General

- 1. Unless otherwise noted, pathway routing shown on the Drawings is illustrative only and meant to indicate the general configuration of the work. Install pathways so that adequate clearances and offsets between pathways and other trades are provided. Coordinate all pathways with other trades prior to installation.
- 2. Permanently mark or tag each raceway at intervals of not more than **75 feet (22.86 m)**, and each junction box and pull box. Permanently mark or tag each raceway that is stubbed into the ceiling space from an outlet box. Identifying them as “TELECOM” or “AV” as appropriate.
- 3. Coordinate the following with cable-installing contractor.
 - a. All supports shall be specifically designed to support the required cable weight and volume. Field manufactured supports will not be accepted.
 - b. All pathways shall include empty space for a minimum of 25% growth beyond initial installation of cabling.
 - c. Provide all communications pathways:
 - 1) So that cables are allowed to be pulled in accordance with referenced standards and guidelines.
 - 2) So that cables are allowed to be pulled without damage to conductors, shield, armor, or jacket.
 - 3) So that cables are not forced or allowed to exceed minimum allowed bend radius by manufacturer or referenced standards and guidelines
 - 4) So that the maximum allowable pulling tension is not exceeded
 - 5) To meet the requirements of the structure and the requirements of all other Work on the Project.
 - 6) Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
 - 7) Parallel or perpendicular to building lines or column lines.
 - 8) When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

- d. Follow manufacturer's recommendations for allowable fill capacity. Do not exceed load ratings specified by manufacturer.
- 4. Access to pathways and associated equipment
 - a. Care shall be taken to ensure that other building components (e.g., air conditioning ducts, pipes, conduits) do not restrict access. Locate all cable trays, open hanger cable supports, j-hooks, pull boxes, junction boxes and fire stopping systems so as to provide easy access for operation, service inspection and maintenance.
 - b. Provide an access door where equipment or devices are located above inaccessible ceilings.
 - c. Pathways requiring access such as open hanger cable supports, j-hooks, and cable trays shall have an access door or other means of direct access at a minimum of **10 feet (3 m)** intervals.
 - d. Cables or cable pathways requiring access such as open hanger cable supports, j-hooks, and cable trays may not change directions above an inaccessible ceiling unless complete access to the change of direction in pathway or cable route is within arms reach **3 feet (0.9 m)** from adjacent accessible point.

B. Conduits and Backboxes for Communications

- 1. Bond and ground all metallic conduits and boxes in accordance with national or local requirements and owner Standards (if applicable).
- 2. Ream all conduit ends and fit them with an insulated bushing to eliminate sharp edges that can damage cables during installation or service.
- 3. Conduits which enter telecommunications rooms shall extend **1 inch (25.4 mm)** to **3 inches (76.2 mm)** AFF.
- 4. Flexible conduits may only be used where specifically allowed by these contract documents.
 - a. Flexible conduit sections shall be less than **20 feet (6.1 m)** in length and shall be increased by (1) trade size
- 5. No continuous section of a conduit may exceed **100 feet (30.5 m)** without a pullbox.
- ~~6. Conduit runs shall not exceed a total of **150 feet (45.7 m)**.~~
- 7. No more than (2) **90°** bends, or equivalent will be allowed between pullboxes.
 - a. Each and any offset shall be considered a **90°** bend.
 - b. A pullbox is required wherever a reverse bend is installed.
- 8. The minimum bend radius for conduits is
 - a. (6) times the inside diameter for **2 inches (50.8 mm)** conduits or less.
 - b. (10) times the inside diameter for conduits greater than **2 inches (50.8 mm)**.
- 9. Install a pull cord in each pathway (empty or not) for installation of new wires or cables. Use polypropylene or monofilament plastic line with not less than 200 lb (90.7 kg) tensile strength. Leave at least 12 inches (**304.8 mm**) of slack at each end of pull cord.
- 10. Provide appropriately sized sleeves where cables are required to pass through non-rated full-height partitions. Rated partitions shall be provided with appropriately rated firestop systems. Where allowed, sleeves shall extend a minimum of **3 inches (76.2 mm)** beyond the partition surface on both sides, and shall be rigidly supported to support the weight of cables. Sleeves shall be sized so that no more than 50% of the cross-sectional area is utilized by the cabling to be installed. The minimum inside diameter of each sleeve shall be nominal **2 inches (50.8 mm)**.
- 11. PullBoxes
 - a. Pullboxes shall be placed in Conveniently Accessible locations.
 - b. Coordinate the location and installation of all pullboxes to ensure adequate access is provided.
 - c. Pullboxes above an accessible ceiling shall:
 - 1) Be aligned directly over the ceiling grid to allow access
 - 2) Be installed with a minimum of **3 inches (76.2 mm)** clearance to ceiling grid and tiles
 - d. No directional changes shall be allowed in pullboxes. Conduit Shall continue in the same direction as it enters and then change direction via an appropriately sized bend in the conduit.
 - e. Size pullboxes according to the following chart:

Conduit Trade Size	Width	Length	Depth	Width Increase for Additional Conduit (of same size)
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3/4" or smaller	4"	4"	2-1/8"	Not applicable
1"	4"	16"	3"	2"
1-1/4"	6"	20"	3"	3"
1-1/2"	8"	28"	4"	4"
2"	8"	36"	4"	5"
2-1/2"	10"	42"	5"	6"
3"	12"	48"	5"	6"
4"	16"	60"	8"	6"

12. Provide an empty EMT raceway from each outlet box into the ceiling space above and terminate with a nylon bushing. In rooms with a non-accessible ceiling, install raceways to the nearest accessible corridor ceiling or as indicated on the Drawings.
13. Contractor may, as an option, stub conduits into the ceiling space on the floor below in multi-story, single-tenant spaces.
14. No outlet boxes shall be located back-to-back in a wall cavity.
 - a. Where possible offset to next stud cavity, but no less than a 6 inches (152.4 mm) separation.
15. Outlet boxes shall be within 3 feet (0.9 m) of nearest electrical outlet.
16. Provide appropriate plaster/mud ring as indicated on the drawings.
17. Provide conduit as indicated on the Drawings or required by this Specification. Minimum communications conduit size shall be 1 inch (25.4 mm). Provide a polypropylene or monofilament plastic line with not less than 200-lb (90.7 kg) tensile strength in each empty conduit. Permanently mark or tag each conduit or pull box, identifying it as Communications, at intervals of not more than 75 feet (22.9 m). Each conduit that is stubbed into the ceiling space from an outlet box shall be permanently marked or tagged.

C. Cable Tray

1. Cable trays shall be installed in accordance with manufacturer installation instructions, applicable electrical code, and standards. Comply with recommendations in NEMA VE 2.
2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
3. Fasten cable tray supports to building structure and install seismic restraints.
 - a. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section " Seismic Controls for Electrical Systems."
 - b. Place supports so that spans do not exceed maximum spans on schedules.
 - c. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - d. Support bus assembly to prevent twisting from eccentric loading.
 - e. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - f. Locate and install supports according to NEMA FG 1.
4. The inside of the cable support system shall be free of burrs, sharp edges or projections that can damage cable insulation. Abrasive supports (e.g., threaded rod) installed within the cable fill area shall have that portion within the tray rigidly protected with a smooth, non-scratching covering so that cable can be pulled without physical damage such as appropriately rated (plenum) plastic tubing.
5. A minimum of 12 inches (300 mm) access headroom shall be provided and maintained above a cable tray system or cable runway.
6. Test cable tray systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with maximum grounding resistance.

D. Ladder Rack

1. Seismic Requirements:

- a. Provide seismic support and bracing, as required, for all cable racking and cable trough installed under this work. Structurally design the cable racking and cable trough installations to accommodate cable loads. No other support mechanism will be supplied. Comply with Division 1 and Division 20 of these Specifications. Provide seismic design calculations and seismic design drawings prepared by the contractor's structural engineer for coordination and approval by Owner prior to fabricating or installing any supports. In general, provide support only from floor slabs, beams, columns, or structural walls (such as shear walls). Do NOT use existing or new partitions to provide either vertical or lateral support UNLESS the seismic design calculations and drawings demonstrate that the partition, either with or without reinforcement, is able to support the seismic and other loads. Any proposed reinforcement to be the responsibility of the Contractor. Coordinate seismic design with architectural, structural, mechanical, electrical, plumbing, fire protection, and other trades. (The General Contractor's office has a copy of structural plans. These should be referred to during entire project.)
- 2. Installation and configuration shall conform to the requirements of the ANSI/TIA Standards 568C & 569, NFPA 70 (National Electrical Code), NEMA VE2, and applicable local codes.
- 3. Install cable ladder racking level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- 4. Install cable ladder racking where indicated in the drawings and as required by these Specifications. At a minimum, provide the following:
 - a. Locate Ladder Rack from wall-to-wall over each anticipated row of Communications equipment racks/cabinets.
 - b. Locate additional horizontal Ladder Rack along the sides of the Communication Room walls as needed to continuously support Communications Cabling from the through-wall sleeves to any (anticipated) equipment rack/cabinet location.
 - 1) Where the through-wall sleeves are located more than 18" above the horizontal Ladder Rack, locate additional vertically-mounted Ladder Rack from the sleeves to the horizontal Ladder Rack.
- 5. Corner clamp brackets shall be used to join sections of cable ladder rack that are perpendicular to each other.
- 6. Cable ladder rack stringers shall be attached to plywood backboards with angle brackets and "J" bolts.
- 7. End supports and stringer junction brackets shall be used to attach vertical cable ladder segments to the floor.
- 8. Stringer junction brackets shall be used to attach end to end horizontal cable ladder rack segments.
- 9. Open ended stringer segments shall be closed with corner clamps and end bars.
- 10. Mounting plates and "J" bolts shall be used to attach the cable ladder racking to the relay racks or equipment cabinets.
- 11. A support shall also be placed within 24 in. on each side of any connection to a fitting.

E. Fire stop System Assemblies for Communications Systems

- 1. Provide systems as identified on the drawings and specified herein. At locations where the cabling routing encounters a fire-rated barrier provide an adequately sized fire stop device for the quantities and types for all cables to be installed plus 25% growth.
- 2. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall, floor or ceiling penetrations; including membrane penetrations. All materials shall be classified or listed as a complete system by approved NRTL by the AHJ and meet NEC and local codes. The use of partial systems or components of systems is not allowed unless specifically identified in the documents.
- 3. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of smoke, flame, toxic gas or water through the penetration before, during or after a fire. The fire rating (F and T) of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by referenced building codes and National Electric Code.
- 4. Provide a label on both sides of fire rated assembly at all fire stop locations indicating:
 - a. Fire stop Manufacturer

- b. Installer and company
- c. Date installed
- d. UL system number with all relevant ratings indicated

3.2 TELECOMMUNICATIONS BACKBOARD

- A. Mount Telecommunications Ground Bars (TMGB and TGBs) to telecommunications backboard.

3.3 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

A. General:

1. Install telecommunications bonding and grounding conductors (wire) without splices or mechanical couplers installed between the wire points of origin and termination except as shown on the Drawings and/or specified herein. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in Telecommunications rooms (spaces). Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage. "Daisy chaining" of Telecommunications ground bus bars back to the TMGB will not be accepted unless specifically indicated on the Telecommunications drawings or specified herein.
2. Unless otherwise noted, all ground wires shall be routed through the Telecommunications cable management pathways so as to achieve a "coupled bonding conductor" effect.
3. Where insulated conductors are necessary provide adequately rated insulation jackets or pathways to meet all required building codes. (I.e. Plenum, riser, outside plant, run entirely in conduit, etc.).
4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds **3 feet (1 meter)** in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum.
5. The bonding conductor for Telecommunications (BCT), each Telecommunications bonding backbone (TBB) conductor, and each grounding equalizer (GE), shall be green or marked with a distinctive green color.
 - a. Marking with a distinctive green color Shall be done at a minimum of every **1 foot (0.3 meter)** by appropriate methods.

B. Required Grounding Connections:

1. Provide and install one individual ground wire from each equipment rack/cabinet/frame (installed under this work) to the TGB in the room. Each conductor is to be "home run"; do not "daisy chain" the connections, except as may be indicated on the drawings.
2. Provide and install one individual ground wire from the raised floor system (provided by another specification section) to the TMGB. Conductor is to be "home run"; do not "daisy chain" the connections, except as may be indicated on the drawings.
3. Provide and install one individual ground wire from the overhead ladder rack (installed under this work) to the TGB in the room.
4. Where electrical panel(s) are located within or dedicated to the TR (installed under this work) install one individual ground wire from each ground bus bar to each electrical panel ground bus
5. Where structural steel is available for connection install one individual ground wire to the nearest structural steel for connection.
6. Provide and install all grounding connections as required by Telecommunications set of drawings (if available).

C. Connector Installation:

1. Provide all ground wire connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
2. Follow the connector manufacturer's instructions for installing the connector to the cable and the connector to the cabinet/rack, ground bar, etc. Use the appropriate tools for the job, tighten nuts/bolts to proper torque, remove paint, insulation, oxidation as needed to assure good metal to metal contact,

etc. If the manufacturer does not provide tightening specifications, follow the recommendations of UL Standard 486.

D. Cable Identification:

1. Label both ends of each ground conductor within **6 inches (152.4 mm)** of a connector terminal or splice. Label the grounding conductors as shown on the Drawings or specified herein. All labels shall include the following in addition to specific labeling requirements for each conductor.

**IF THIS CONNECTOR OR CABLE IS
LOOSE OR MUST BE REMOVED,
PLEASE CALL THE BUILDING
TELECOMMUNICATIONS
MANAGER**

E. Quantities of Ground Wire

1. Location and placement of grounding and bonding wires and components shall be as shown on the Drawings or defined herein.
2. Quantities of ground wires, bonding components, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of materials to construct a grounding and bonding system that meets the intent of these Specifications and the relevant codes.

F. Testing

1. Test the grounding conductor and the terminal connectors for total resistance between the equipment item being grounded and the main telecommunications grounding point in the room. This resistance shall be less than 0.10 Ohm.
2. Recommended test equipment:
 - a. An ohmmeter capable of indicating resistance down to 10 milli-ohms or below.

G. Record Drawings

1. The Project Record Drawings shall show the types and locations of installed grounding and bonding conductors.

END OF SECTION

SECTION 16465 (260513) - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cables rated over 600V.
- B. Splice Kits
- C. Solid Terminations
- D. Separable Insulated Connectors
- E. Arc-Proofing Materials
- F. Fault Indicators

1.2 DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these specifications:
 - 1. NETA ATS: Acceptance Testing Specification.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
 - 1. Product data for the following products:
 - a. Cables
 - b. Splice Kits
 - c. Solid Terminations
 - d. Separable Insulated Connectors
 - e. Arc-Proofing Materials
 - f. Fault Indicators
 - 2. Samples:
 - a. 16-inch (400-mm) lengths of each type of cable indicated.
 - b. <
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Qualification Data:
 - 1. For Installer.
 - 2. For testing agency.
- E. Material Certificates: For each cable and accessory type, signed by manufacturers.
- F. Source quality-control test reports.

- G. Field quality-control test reports in accordance with NETA ATS.
 - 1. Shield continuity test for each power cable.
 - 2. Insulation resistance test for each power cable.
 - 3. Resistance measurements through all bolted connections.
 - 4. dc High-Potential test on all power cables.
- H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- I. Operation and Maintenance Data: For cable and all accessories to include in operation and maintenance manuals.
- J. Follow-up service reports.

1.4 QUALITY ASSURANCE

- A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.
- B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- C. Provide products listed and classified by Underwriters Laboratories, Inc (UL) as suitable for the purpose specified and indicated.
- D. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- E. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- F. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- H. Comply with [NFPA 70

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Do not interrupt electric service to occupied facilities. Refer to Division 26 Section "General Electrical Requirements" for allowable outages.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Cables:

- a. General Cable Technologies Corporation.
- b. Hendrix-Kerite Co. (The); a Marmon Wire Company.
- c. Okonite Company (The).
- d. Prysmian
- e. Southwire Company.
- 2. Cable Splicing and Terminating Products and Accessories:
 - a. Engineered Products Company.
 - b. G&W Electric Company.
 - c. MPHusky.
 - d. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
 - e. RTE Components; Cooper Power Systems, Inc.
 - f. Scott Fetzer Co. (The); Adalet.
 - g. Thomas & Betts Corporation.
 - h. Thomas & Betts Corporation/Elastimold.
 - i. 3M; Electrical Products Division.

2.2 CABLES

- A. Cable Type: MV90
- B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682 and ICEA S-94-649.
- C. Conductor: Aluminum.
 - 1. Conductor Stranding: Compact round
 - 2. Provide conductor material with lead content less than 300 parts per million.
- D. Strand Filling: Conductor interstices are filled with impermeable compound.
- E. Conductor Insulation] [Crosslinked polyethylene].
 - 1. Voltage Rating: 15kV.
 - 2. Insulation Thickness: [133] percent insulation level.
- F. Neutral Conductor: [Full neutral]
- G. Shielding: [Copper tape]
- H. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.
- I. Three-Conductor Cable Assembly: Three insulated, shielded conductors cabled together with ground conductors.
 - 1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.
- J. Cable Jacket: Chlorinated polyethylene, CPE

2.3 SPLICE KITS

- A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with re-jacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
3. Pre-molded, cold-shrink-rubber, in-line splicing kit.
4. Pre-molded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.4 SOLID TERMINATIONS

- A. Multi-conductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.
 1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.
 2. Heat-shrink sheath seal kit with phase- and ground-conductor re-jacketing tubes, cable-end sealing boot, and sealing plugs for unused ground-wire openings in boot.
 3. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged, two-part, epoxy-resin casting material.
- B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.
 1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
 2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer non-tracking tubes; multiple, molded, non-tracking skirt modules; and compression-type connector.
 3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
- C. Non-shielded-Cable Terminations: Kit with compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.

2.5 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- C. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.
 1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.

- 2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
 - 3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
 - 4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.
- F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, compatible with cable jacket.
- C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch (13 mm) wide.

2.7 FAULT INDICATORS

- A. Indicators: Automatically reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.
- B. Resetting Tool: Designed for use with fault indicators, with moisture-resistant storage and carrying case.

2.8 SINGLE CONDUCTOR IDENTIFICATION

- A. Over 600 Volts, insulated conductors as noted above shall be color-coded as follows, unless noted otherwise:

PHASE

A	Black
B	Red
C	Blue
Neutral	White
Equipment Ground	Green

2.9 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to ICEA S-97-682 [ICEA S-94-649 before shipping.
- B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cables according to IEEE 576.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Common Work Results for Electrical."
- F. Install direct-buried cables on leveled and tamped bed of 3-inch- (76-mm-) thick, clean sand. Separate cables crossing other cables or piping by a minimum of 4 inches (100 mm) of tamped earth. Install permanent markers at ends of cable runs, changes in direction, and buried splices.
- G. Install "buried-cable" red-warning tape with tracer wire 12 inches (305 mm) above cables.
- H. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.
- I. Install cable splices at pull points and elsewhere as indicated; use standard kits.
- J. Install terminations at ends of conductors and seal multi-conductor cable ends with standard kits.
- K. Install separable insulated-connector components as follows:
 - 1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
 - 2. Portable Feed-Through Accessory: Three.
 - 3. Standoff Insulator: Three.
- L. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
 - 1. Clean cable sheath.
 - 2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
 - 3. Smooth surface contours with electrical insulation putty.
 - 4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable. Extend arc-proofing tape 1 inch (25 mm) into raceway or duct.
 - 5. Band arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape at 36 inches (1-meter) o.c. Apply banding at start and stop of arc proof tape, where conductors enter and exit enclosures or pulling points, and at both ends and the middle of splice points.
- M. Seal around cables passing through fire-rated elements according to Division 07 Section "Penetration Firestopping."

- N. Install fault indicators on each phase where indicated.
- O. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- P. Identify cables according to Division 26 Section "Identification for Electrical Systems."

3.2 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Power-Circuit Conductor Identification: For primary and secondary conductors in vaults, pull and junction boxes, manholes, and handholes identify voltage, source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Test Reports: Prepare written reports to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

END OF SECTION

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SECTION 16402 (260519) – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Conductors, cables, and cords rated 600V and less.
 - 2. Connectors and terminations rated 600V and less.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section “Common Work Results for Electrical” for sleeves and seals for electrical penetrations.
- C. Division 26 Section “Grounding and Bonding for Electrical Systems” for conductors and connectors for grounding systems.
- D. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.
- E. Division 23 Section “Direct-Digital Control for HVAC” for temperature control wiring.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
- B. Qualification Data: For testing agency.
- C. Field Quality-Control Test Reports.

1.4 ABBREVIATIONS AND DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these specifications:
 - 1. MC: Metal Clad
 - 2. NBR: Acrylonitrile-butadiene rubber
- B. The following definitions apply to this and other Sections of these Specifications:
 - 1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

1.5 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
- D. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 - 2. Marked for intended use.
- E. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUCTORS AND CABLES

- A. General
 - 1. Manufacturers:
 - a. AFC Cable Systems, Inc.
 - b. Alan Wire
 - c. Cerrowire
 - d. Colonial Wire & Cable
 - e. Encore Wire Corporation
 - f. General Cable
 - g. Northern Cables Inc.
 - h. Okonite Company
 - i. Southwire Company
 - 2. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable; solid conductor for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger and stranded for all flexible cords, cables, and control wiring or as noted otherwise below.
 - 3. Conductor Insulation Types: Type THW THHN/THWN-2 and/or XHHW-2 complying with ICEA S-95-658/NEMA WC70 or as noted otherwise below.
 - 4. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).
 - 5. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.

6. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- B. Metal Clad Cable, Type MC (for non-patient care areas only. Do not use for life safety or critical systems.)
1. MC Cable (with insulated green grounding conductor, no bonding conductor):
 - a. Manufacturers:
 - 1) AFC Cable Systems, Inc (MC Lite)
 - 2) Encore Wire Corporation (MC)
 - 3) Kaf-Tech
 - 4) Southwire Company (Amorlite)
 - b. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
 - c. Armor Assembly: Aluminum interlocked armor (aluminum color).
 - d. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
 - e. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NEC Table 250.122.
 - f. Marking: Cable markings shall comply with the requirements on NEC ART. 310.11.
 2. MC Cable (with 0-10V dimming control wiring):
 - a. Manufacturers:
 - 1) AFC Cable Systems, Inc (MC- PCS)
 - 2) Encore Wire Corporation (MC- LED)
 - 3) Southwire Company (MC – PCS Duo)
 - b. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
 - c. Armor Assembly: Aluminum interlocked armor (aluminum color).
 - d. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
 - e. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NEC Table 250.122.
 - f. Control Conductors: color coded class2/class3 twisted jacketed pairs
 - g. Marking: Cable markings shall comply with the requirements of NEC Art 310 .11(1).
 3. MC Cable Fittings:
 - a. Manufacturer & Model:
 - 1) Arlington (4010 AST snap-in type): (SG38 saddle type)
 - 2) Crouse-Hinds (QLK Quick-Lok Series, Saddle type); ACB Series; set-screw, saddle type)
 - 3) O-Z Gedney (AMC-50 speed-lok, saddle type)
 - 4) Thomas & Betts (XC-730 Series cable-lok, saddle type); 3110 Series Tite-Bite)
 - b. Fittings used for connecting Type MC cable to boxes, cabinets, or other equipment shall be UL listed and identified for such use with an MCI-A marking on the fitting carton or package.
 - c. Fittings shall be insulated type not requiring the use of anti-short bushings.
 - d. Romex style, clamp type fittings are not acceptable.
- C. Single Conductors
1. 600V, THW-,THHN/THWN-2 and/or XHHW-insulated conductors, color-coded as follows:

PHASE	120/240V	240Δ/120V	208Y/120V	480Y/277V
A	Black	Black	Black	Brown
B	Red	Orange	Red	Orange
C	N/A	Red	Blue	Yellow
Neutral	White	White	White	Gray**
Equipment Ground	Green	Green	Green	Green
Isolated Ground	N/A	N/A	Green/Yellow Stripe	N/A

**Except as provided in NFPA 70.]

2. Where local amendments dictate color-coding of conductors, local amendments shall supersede these color-coding requirements.
3. Conductors shall not be smaller than No. 12 AWG, except that wiring for signal and pilot control circuits and pre-manufactured whips for light fixtures may be No. 14 AWG.

D. Flexible Cords

1. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black or yellow jacket, extra-hard-usage; Type SEO, SO, or STO for indoor dry and damp locations; [SEOW,] [SOW,] [or] [STOW] for damp, wet, and outdoor locations

E. Control Wiring

1. Refer to Division 23 Section "Direct-Digital Control for HVAC"
2. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

F. Connectors

1. Manufacturers:
 - a. AMP; Tyco
 - b. FCI-Burndy
 - c. Gould
 - d. Ideal Industries, Inc.
 - e. IlSCO
 - f. NSi Industries, Inc.
 - g. O-Z/Gedney
 - h. Panduit
 - i. Thomas and Betts
 - j. 3-M Electrical Products Division
2. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, bare copper, circumferential compression type (Burndy "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - a. Termination fittings: 1-hole pad and inspection port.
3. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, bare copper, dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - a. Termination fittings: 1-hole pad and inspection port.
4. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
5. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: ring-tongue type.
6. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.

PART 3 - EXECUTION

3.1 CONDUCTORS AND CABLES

A. General:

1. Unless otherwise indicated on the Drawings or in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 8 inches of conductor at outlets for fixture or device connections.
2. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
3. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
4. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.
5. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).
6. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
7. Seal around cables penetrating fire-rated elements according to Division 07 Section "Penetration Firestopping".
8. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems".
9. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
10. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
11. Multi-wire branch circuits (i.e., shared neutral) shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two examples.
12. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:
 - a. Emergency Power Circuits – includes all circuits covered under Articles 700, 701 and 702.
 - 1) Maximum of eight conductors in a single raceway. Minimum raceway size: ¾-inch. Do not install any other type of circuit in this raceway.
 - 2) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
 - b. Normal or Non-Essential circuits.
 - 1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
 - 2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
 - 3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
 - c. GFCI-protected circuits.
 - 1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.
 - d. Isolated Ground (IG) Circuits:

- 1) Do not use multi-conductor or MC cables.
 - 2) Do not share neutrals between separate circuits.
 - 3) Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
 - 4) The equipment grounding conductor may be shared between IG circuits sharing a common raceway.
13. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
 14. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
 15. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:
 - a. Wet or dry locations, in raceways:
 - 1) Service entrance: Type THWN, THHN/THWN-2, or XHHW.
 - 2) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW.
 - 3) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.
 - b. Direct buried:
 - 1) Service entrance: USE.
 - 2) Feeders and branch circuits: UF or USE.
 - c. Fluorescent light fixtures or conductors within three feet of high temperature equipment such as heaters: Type THHN, XHHW, or higher temperature insulation as required for the use.

B. Aluminum Conductor Option:

1. Terminations: Tinned, [mechanical] [compression] type only; UL-listed for copper and aluminum conductors at 75 degrees C minimum.
2. Increase the raceway size as required, at no additional cost to the Owner, to accommodate the increased size of the aluminum conductors.
3. Aluminum conductor size shall meet or exceed the ampere rating of the scheduled copper conductors at 75 degrees C.
4. Option applies only for the following feeders or services No. 2 AWG and larger (based on copper conductors):
 - a. Service entrance conductors
 - b. Feeders to switchboards
 - c. Feeders to panelboards
 - 1) Exception: Apartment unit load center feeder conductors shall be copper; aluminum is not acceptable.
 - d. Feeders to motor control centers
 - e. Feeders to transformers
5. Where aluminum conductors terminate existing panelboards, switchboards or switchgear that utilize compression connections use hydraulic-compression type connectors with a zinc base, anti-oxidizing compound. Use compression tools of the type that will not release unless the correct pressure has been applied.
6. Measure the temperature of all aluminum conductors at all splices and terminations. Make each test under typical building load conditions after the building is occupied and in operation for a minimum of two weeks. Replace all joints or splices indicating excessive heating.
7. Take measurements with a non-contact type infrared thermometer, with target size not exceeding one inch at five feet and an accuracy of two percent or better. Submit the meter specifications and calibration date with the test results.

C. Metal Clad Type MC Cable:

1. Securing and Supporting:
 - a. Support per Art 330 for MC cable
 - b. Secure cable within 12 inches of every box or fitting.

- c. Secure/supporting intervals shall not exceed six (6) feet for MC cable.
 - d. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible so as to provide for cable routing in a neat and workmanship like manner.
2. Type MC cable may only be used:
- a. In lieu of flexible conduit and wiring from light fixtures in accessible ceilings to junction boxes (attached to building structure) above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.
 - b. For vertical drops [and horizontal wiring] in stud walls.
3. MC Cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
- a. In locations not permitted by the NEC.
 - b. When specifically not allowed by the local AHJ [and/or Owner/Landlord].
 - c. Homeruns to panelboards. Note: where metal clad cable is utilized for receptacle, lighting, and/or miscellaneous load branch circuiting, the originating point of the homerun shall be at the first (most upstream) load in the circuit or at a junction box located in the accessible ceiling space immediately above the first (most upstream) load. Reference definitions in this section for definition on "Homerun".
 - d. Where exposed to view.
 - e. Where subject to physical damage.
 - f. Corrosive or Hazardous locations.
 - g. Wet locations.
 - h. Emergency systems (life safety and critical branches) of Health Care facilities accept as allowed by Art 517.30(C)(3).
 - i. Emergency circuits covered by NFPA Art 700 Emergency Systems
 - j.

D. Flexible Cords

- 1. Refer to Division 26 Section, "Equipment Wiring Systems", for electrical connections to equipment.

E. Control Wiring

- 1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
- 2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.

F. Connections:

- 1. Apply a zinc based, anti-oxidizing compound to connections.
- 2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- 3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- 4. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- 5. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.
- 6. Connect conductors No. 6 AWG and larger to panelboards and apparatus by means of approved mechanical lugs or compression connectors.
- 7. Do not use terminals on wiring devices to feed through to the next device.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.

- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 16170 (260526) – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. This Section includes:
 - 1. Grounding Electrodes
 - 2. Ground Bars
 - 3. Grounding Conductors
 - 4. Connector Products
 - 5. Equipotential Grounding System
 - 6. Miscellaneous Grounding Materials and Products

1.2 DEFINITIONS

- A. The following apply to this and other Sections of these Specifications:
 - 1. Ground ring: Bare underground grounding conductor encircling the building or structure.
 - 2. NETA ATS: Acceptance Testing Specification.
 - 3. PSF: Pounds per Square Foot
 - 4. EMT: Electrical metallic tubing.
 - 5. ENT: Electrical nonmetallic tubing.
 - 6. FMC: Flexible metal conduit.
 - 7. GRS: Galvanized Rigid Steel Conduit
 - 8. IMC: Intermediate metal conduit.
 - 9. LFMC: Liquidtight flexible metal conduit.
 - 10. LFNC: Liquidtight flexible nonmetallic conduit.
 - 11. RAC: Rigid Aluminum Conduit
 - 12. RMC: Rigid Metal Conduit
 - 13. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Product data for the following products:
 - a. Electrodes, mechanical and compression connectors, and exothermic connectors .

1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.

3. Comply with UL 467.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- E. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 GROUNDING CONDUCTORS, CONNECTORS, AND ELECTRODES:

- A. Manufacturers:
 1. ABB, Inc.
 2. Advanced Lightning Technology (ALT)
 3. AFL Global
 4. Boggs, Inc.
 5. Burndy; Hubbell.
 6. Cooper Power; Eaton.
 7. Copperweld Corp.
 8. ECN/Korns; Division of Robroy Industries.
 9. Erico; nVent.
 10. Galvan Industries, Inc.
 11. Greaves Corp.
 12. Harger.
 13. Hastings Fiber Glass Products, Inc.
 14. Heary Brothers Lightning Protection Co.
 15. Ideal Industries, Inc.
 16. ILSCO.
 17. Lightning Master Corp.
 18. Lyncole XIT Grounding; Division of VFC.
 19. O-Z/Gedney Co.; Emerson.
 20. Panduit, Inc
 21. RACO; Hubbell, Inc.
 22. Robbins Lightning, Inc.
 23. Superior Grounding Systems, Inc.

2.2 GROUNDING ELECTRODES

- A. Ground Rods: UL-listed:
 1. Copper-clad steel; bonded copper electrolytically-applied to minimum thickness of 10 mils.
 2. Hot-dip galvanized steel; minimum zinc thickness specified per ASTM A-123.
 3. Size: 3/4 inch by 10 feet. Provide sectional types when longer rods are indicated.
- B. Ground Ring:
 1. Bare copper grounding conductor, size as noted on Drawings but not less than #2/0 AWG.

2.3 GROUND BARS

- A. General
 1. Ground bars described in this section are intended to be wall mounted bars used for grounding and bonding. Equipment ground buses for switchboards, panelboards and miscellaneous equipment are described in the individual equipment sections.
 2. Supports: Minimum of two each 1-1/2-inch insulators and 1-inch stainless steel offset mounting brackets.

- B. Electrical Room Ground Bars
 - 2. Rectangular Ground Bars: bare, 1/4 inch thick, electrolytic, tough pitch copper bar, 4 inches wide. Length as indicated on the Drawings but not less than 24 inches long. Hole spacing as required for conductor lugs.
- C. Telecommunications Main Grounding Busbar (TMGB)
 - 1. Rectangular Ground Bars: UL & cUL Listed to UL467 & C22.2 respectively, pre-drilled per TIA/EIA Standard 607A, bare, 1/4 inch thick, electrolytic, tough pitch copper bar, 4 inches wide. Length as indicated on the Drawings but not less than 24 inches long.
- D. Telecommunications Grounding Busbar (TGB)
 - 1. Rectangular Ground Bars: UL & cUL Listed to UL467 & C22.2 respectively, pre-drilled per TIA/EIA Standard 607B, bare, 1/4 inch thick, electrolytic, tough pitch copper bar, 2 inches wide. Length as indicated on the Drawings but not less than 24 inches long.

2.4 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- B. Material:
 - 3. Aluminum.
 - 4. Copper-clad aluminum.
 - 5. Copper.
- C. Equipment Grounding Conductors: Insulated and identified as indicated in Part 3 of this section.
- D. Isolated Ground Conductors: Insulated and identified as indicated in Part 3 of this section.
- E. Grounding Electrode Conductors: Bare, stranded, unless otherwise indicated.
- F. Underground Conductors:
 - 6. Tinned-copper conductor.
 - 7. No. 2/0 AWG minimum
 - 8. Solid, unless otherwise indicated.
- G. Bare Copper Conductors:
 - 1. Solid Conductors: Comply with Conductors: ASTM B 8.
 - 2. Tinned Conductors: Comply with ASTM B 33.
- H. Copper Bonding Conductors:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (wide and 1/16 inch thick).
- I. Aluminum Bonding Conductors:
 - 1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
 - 3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

J. Ground Ring:

9. Bare copper grounding conductor, size as noted on Drawings but not less than #2/0 AWG.

K. Ground Conductor and Conductor Protector for Wood Poles: As follows:

1. No. 4 AWG minimum, soft-drawn copper conductor.
2. Conductor Protector: Half-round PVC or wood molding. If wood molding is utilized, use pressure-treated fir, or cypress or cedar.

2.5 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors.
- C. Compression Connectors: Burndy Hyground, or equal, permanent, pure, wrought copper, meeting ASTM 8 1 87, essentially the same as the conductors being connected; clearly and permanently marked with the information listed below:
 10. Company symbol and/or logo.
 11. Catalog number.
 12. Conductors accommodated.
 13. Installation die index number or die catalog number is required.
 14. Underwriters Laboratories "Listing Mark:".
 15. The words "Suitable for Direct Burial" or, where space is limited, "Direct Burial" or "Burial" per UL Standard ANSI/UL467.
- D. Cast connectors: copper base alloy according to ASTM B 30.
- E. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.6 MISCELLANEOUS

- A. Test Wells:
 1. Traffic Areas: Polymer concrete reinforced with heavy weave fiberglass; H-20 load rating; minimum 24 inches deep.
 2. Non-traffic Areas: High density polyethylene; 350 PSF minimum load rating; minimum 10.25 inches deep.
 3. Cover: Factory-identified by permanent means with word "GROUND".
- B. Ground Enhancing Backfill: Provide low-resistivity, ground-enhancing backfill material recommended by the electrode manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Contract Administrator and the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

16. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of NFPA 70 and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.
17. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.
18. Where the size of the grounding conductors are not shown, size in accordance with NFPA 70 Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Application:

19. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
20. Underground Grounding Conductors: Unless noted otherwise, bury at least 36 inches below grade, or 6 inches below the official frost line, whichever is greater, or when crossing a duct bank, bury 12 inches above duct bank.

B. Grounding Electrode System: Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

1. Provide continuous grounding electrode conductors without splice or joint.
2. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
3. Ground Rod Electrodes:
 - a. Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - b. Unless otherwise indicated, install ground rod electrodes vertically.
 - 1) Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 - 2) Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
 - c. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70. If depth is unachievable, notify Contract Administrator and Engineer.
 - d. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
 - e. Verify that final backfill and compaction has been completed before driving rod electrodes.
 - f. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade, pavement, or floor.
4. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches. Use exothermic weld to secure grounding electrode conductor.
5. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare, tinned copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor above footer and foundation and connect to building structural steel or other grounding electrode external to concrete.
6. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
7. Ground Ring Electrode (Counterpoise):

- a. Provide a ground ring encircling the building or structure, in direct contact with earth., installed at a depth of not less than 18 inches or 6 inches below the official frost line, whichever is greater.
 - b. Locate ground ring conductor at least 24 inches outside building perimeter foundation, unless noted otherwise on the Drawings.
 - c. Provide ground enhancement material around conductor where indicated.
 - 8. Metal In-Ground Support Structures: Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 9. Metal Poles Supporting Outdoor Luminaires: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- C. Equipment Grounding Conductors:
- 1. Comply with NFPA 70, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
 - 2. Install equipment grounding conductors in all feeders and branch circuits.
 - 3. In branch circuit and feeder raceways, use insulated equipment grounding conductors.
 - 4. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
 - 5. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components. On water heaters, bond metal hot and cold water pipes together, across the heater tank.
 - 6. Busway Supply Circuits: Install an insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panelboard to the equipment grounding bar terminal on the busway, if a direct bus-to-bus connection is not factory provided.
 - 7. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panelboards or power-distribution units.
 - 8. Metallic Cable Tray Systems: Install equipment grounding conductor in each cable tray. Do not use metal cable tray system as sole equipment grounding conductor.
 - a. Equipment Grounding Conductor for Steel Cable Tray: Use bare or insulated copper conductor.
 - b. Equipment Grounding Conductor for Aluminum Cable Tray: Use insulated copper conductor only; do not use bare copper conductor.
 - c. Minimum Equipment Grounding Conductor Size: 6 AWG copper.
 - 9. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Ground Bars:
- 1. Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated on the Drawings.
 - a. Use insulated spacers and mounting brackets, and support from wall 2 feet above finished floor, unless otherwise indicated.
- C. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
- 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ground bar.
 - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Separately Derived Systems: Bond the derived neutral (grounded) conductor of all separately derived system (e.g., transformers, generators, UPS) to the nearest available grounding electrode, or back to the service grounding electrode if no approved electrodes are readily available. Size the grounding

electrode conductor and bonding jumpers as indicated on the Drawings or as required by NFPA 70, whichever is larger.

- E. Bonding: Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70:
 - 1. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
 - 2. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
 - 3. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
 - 4. Bond metallic elements likely to become energized or where indicated on the Drawings, including but not limited to fences around electrical equipment and metal drain bodies near pools or electrical equipment.
 - 5. Bond raised flooring systems and static control flooring.
 - 6. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
 - 7. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in PVC conduit.
 - 8. Pole Mounted Luminaires: Bond metal enclosures and components of pole mounted luminaires to the grounding system per the Manufacturer's requirements.
 - 9. Bond the components within the following systems to the building grounding system:
 - a. Metallic Cable Tray Systems.
 - b. Photovoltaic Systems.
- E. Isolated Ground (IG) Receptacle Circuits:
 - 10. Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - 11. Do not use multi-conductor or MC cables.
 - 12. Do not share neutrals between separate circuits.
 - 13. Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
 - 14. The equipment grounding conductor may be shared between IG circuits sharing a common raceway
- F. Isolated Equipment Enclosure Circuits:
 - 1. For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - a.

1.2 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically

compatible. Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Replace welds that are puffed up or that show convex surfaces indicating improper cleaning. Use exothermic welded connections for the following:
1. Connecting conductors together.
 2. Connecting conductors to ground rods, except at test wells.
 3. Connecting conductors to building steel.
 4. Connecting conductors to plates.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
1. Compression Fittings: Permanent compression-type fittings may be used for the following rather than exothermic connections:
 - a. Connecting conductors together.
 - b. Connecting conductors to building steel.
 - c. Connecting conductors to ground rods, except at test wells.
- D. Mechanical Pressure-Type Connections: Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
1. Mechanical Pressure Fittings: Use bolted mechanical (removable) pressure-type clamps for the following:
 - a. Connecting conductors to ground rods at test wells.
 - b. Connecting conductors to pipes.
- E. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- F. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- G. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

1.3 GROUND RING

- A. Ground the steel framework of the building with a buried electrode at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Protect taps for steel framing connections from physical damage at foundations and transitions to steel columns.
- B. ces.

1.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 6 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise encircling the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade, or 6 inches below the official frost line, whichever is greater, and 6 inches from the foundation.

1.5 IDENTIFICATION

- F. Provide identification as specified in Division 26 “Low-Voltage Electrical Power Conductors and Cables” and “Identification for Electrical Systems”.

1.6 FIELD QUALITY CONTROL

- G. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - 4. Inspect and test in accordance with NETA ATS, except Section 4.
 - 5. Perform inspections and tests listed in NETA ATS, Section 7.13.

6. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
7. Perform point-to-point megohmmeter tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
8. Test Values:
 - a. The resistance between the main grounding electrode and earth ground shall be no greater than 10 ohms.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - d. Equipment Rated More Than 1000 kVA: 3 ohms.
 - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - f. Manhole Grounds: 10 ohms.
9. Minimum system neutral-to-ground insulation resistance: one megohm.
10. Investigate point-to-point resistance values that exceed 0.5 ohms.
 - a. Check for loose connections.
 - b. Check for absent or broken connections.
 - c. Check for poor quality welds.
 - d. Consider other reasons.
11. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements
12. Excessive Grounding Electrode Resistance: If measured resistance to earth ground value exceeds specified values, add grounding electrodes and additional conductors as required to obtain the specified value.
13. Submit detailed reports indicating inspection and testing results and corrective actions taken.

1.7 GRADING AND PLANTING

- H. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 31 and 32. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16072 (260529) - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section “Common Work Results for Electrical” for concrete pads for pad-mounted service transformers.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1)
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as [required by 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete"
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 16152 (260533) – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes:
 - 1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section “Common Work Results for Electrical” for limited scope general construction materials and methods.
- C. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.
- D. Division 26 Section “Grounding and Bonding”.
- E. Division 26 Section “Hangers and Supports for Electrical Systems”.
- F. Division 26 Section “Under Floor Raceways for Electrical Systems”.
- G. Division 26 Section “Underground Ducts and Raceways for Electrical Systems”.
- H. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for supports, anchors, concrete bases, seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
- I. Division 26 Section “Identification for Electrical Systems”.
- J. Division 26 Section "Wiring Devices" for devices installed in boxes, power poles, and multi-outlet assemblies.
- K. Division 26/27 Section “Common Work Results for Communications”.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.
- B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Accurately record actual routing of all exterior buried raceway and all interior raceways three inches and larger. Indicate dimensions from fixed structural elements.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in path of conduit groups with supports.
 - 2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.

1.4 DEFINITIONS

- A. Terminology used in this specification is as defined below:
 - 1. EMT: Electrical Metallic Tubing
 - 2. FMC: Flexible Metal Conduit
 - 3. GRS: Galvanized Rigid Steel Conduit
 - 4. IMC: Intermediate Metal Conduit
 - 5. LFMC: Liquidtight Flexible Metal Conduit
 - 6. LFNC: Liquidtight Flexible Nonmetallic Conduit
 - 7. RAC: Rigid Aluminum Conduit
 - 8. RMC: Rigid Metal Conduit
 - 9. RNC: Rigid Nonmetallic Conduit

1.5 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 - 2. Marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

- A. Metal Conduit And Tubing
 - 1. Manufacturers:
 - a. AFC Cable Systems, Inc.
 - b. Alflex Corporation, a Southwire Company
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Electri-Flex Co.
 - e. Indalex
 - f. Manhattan/CDT/Cole-Flex
 - g. O-Z/Gedney; Unit of General Signal (Fittings)
 - h. Republic Raceway
 - i. Tyco International; Allied Tube & Conduit Div.
 - j. Western Tube and Conduit Corporation
 - k. Wheatland Tube Co.
 - 2. RMC:
 - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.

- b. RAC: ANSI C80.5, UL6A.
- 3. IMC: ANSI C80.6, UL 1242.
- 4. EMT and Fittings: ANSI C80.3, UL 797.
 - a. Fittings: Set-screw or compression\ type.
- 5. FMC: Aluminum: UL 1.
- 6. LFMC: Flexible steel raceway with PVC jacket: UL 360.
 - a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

- 1. Manufacturers:
 - a. AFC Cable Systems, Inc. (Tubing)
 - b. American International.
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Arnco Corp.
 - e. Cantex Inc.
 - f. Certaineed Corp.; Pipe & Plastics Group.
 - g. Condux International.
 - h. ElecSYS, Inc.
 - i. Electri-Flex Co.
 - j. Lamson & Sessions; Carlon Electrical Products.
 - k. Manhattan/CDT/Cole-Flex.
 - l. Prime Conduit (formerly Carlon)
 - m. RACO; Division of Hubbell, Inc.
 - n. Spiralduct, Inc./AFC Cable Systems, Inc.
 - o. Superflex Ltd.
 - p. Thomas & Betts Corporation.
- 2. RNC: Schedule 40 PVC: NEMA TC 2, UL 651.
 - a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. Metal Wireways

- 1. Manufacturers:
 - a. Cooper B-Line
 - b. EPI-Electrical Enclosures
 - c. Hoffman.
 - d. Square D.
- 2. Material and Construction: 14 gauge (minimum) sheet steel, sized and shaped as indicated, NEMA 1.
- 3. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70. Where indicated, provide a barrier to divide wireway into compartments.
- 4. Wireway Covers: Screw-cover type.
- 5. Finish: Manufacturer's standard phosphate pre-treatment and baked enamel finish.

D. Nonmetallic Wireways

- 1. Manufacturers:
 - a. Enduro Composite Systems
 - b. Hoffman.
 - c. Lamson & Sessions; Carlon Electrical Products.
- 2. Description: Fiberglass reinforced polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Gasketed cover with oil-resistant gasket material and fastened with corrosion resistance captive screws or with snap-on covers and cover splice plates; flanged connections, with stainless-steel screws and oil-resistant gaskets.

3. Description: PVC, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
4. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
5. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.3 BOXES, ENCLOSURES AND CABINETS

A. General

1. Manufacturers:
 - a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - b. Emerson/General Signal; Appleton Electric Company.
 - c. Erickson Electrical Equipment Co.
 - d. Hoffman.
 - e. Hubbell, Inc.
 - f. Killark Electric Manufacturing Co.
 - g. O-Z/Gedney; Unit of General Signal.
 - h. RACO; Division of Hubbell, Inc.
 - i. Robroy Industries, Inc.; Enclosure Division.
 - j. Scott Fetzer Co.; Adalet-PLM Division.
 - k. Spring City Electrical Manufacturing Co.
 - l. Thomas & Betts Corporation.
 - m. Walker Systems, Inc.; Wiremold Company (The).
 - n. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Outlet Boxes

1. Sheet Metal Outlet and Device Boxes: NEMA OS 1; UL514A.
2. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
3. Nonmetallic Outlet and Device Boxes: NEMA OS 2
4. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Manufacturers listed above and models that meet the specified criteria.
 - a. Boxes for exposed work: deep drawn type with raised covers:
 - 1) Appleton 4S 1/2-DR; 8300 series cover.
 - 2) RACO 190 series; 800 series cover.
 - 3) Steel City 52150 series; RS series cover.
 - b. Concealed and exposed boxes for lighting:
 - 1) Appleton 40-3/4.
 - 2) RACO 160 series.
 - 3) Steel City 54170 series.
 - c. Boxes imbedded in concrete for lighting:
 - 1) Appleton OCR
 - 2) RACO 270 or 280 series.
 - 3) Steel City 54500 series.
 - d. Boxes for flush switches, receptacles, or other general devices:
 - 1) Appleton 4SVB series; 8400 series cover.
 - 2) RACO 198 series; 770 series cover.
 - 3) Steel City CWV series; 52-C-00 series cover.
 - e. Boxes for flush switches, receptacles, or other general devices installed in masonry construction:
 - 1) Appleton MI-250 series or MI-350 series.

- 2) RACO 690 series or 960 series.
- 3) Steel City GW series.
- f. Boxes for telephone, data, telecommunications and audio-video outlets, refer to Division 26 Section "Common Work Results for Communications".
- g. Exposed weatherproof boxes for general devices: cast aluminum with mounting lugs and neoprene gasket:
 - 1) Appleton FDB series.
 - 2) RACO 5300 series.
 - 3) Steel City T100L or LT100L series.
- h. Exposed weatherproof boxes for general devices: cast aluminum with neoprene gasket:
 - 1) Appleton FS series.
 - 2) RACO 5300 series.
 - 3) Steel City T100 or LT100 series.

C. Junction and Pull Boxes

- 1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- 2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

D. Floor Boxes

- 1. General:
 - a. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the tables below. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Manufacturers listed above and models that meet the specified criteria.
 - b. Floor boxes used for power: Include a minimum of one normal 20A, 125V NEMA 5-20R duplex receptacle unless noted or scheduled otherwise on the Drawings. Wiring device color: Refer to Division 26 Section "Wiring Devices", or as indicated on the Drawings.
 - c. Floor boxes utilized for telephone, data, or both: Include provisions for mounting telephone/data outlets in accordance with the requirements of the telephone/data systems provider.
 - d. UL514A listed for scrub water exclusion for all floor types.
- 2. Box Type A : For slab on grade: round-faced, watertight, Class 1, fully adjustable cast iron box. For slab above grade: round-faced, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

<u>MFR</u>	<u>CAST IRON BOX</u>	<u>STAMPED STEEL BOX</u>	<u>COVER PLATE (POWER)</u>	<u>COVER PLATE (TEL/DATA)</u>	<u>CARPET TRIM</u>
Steel City	602	68D	P60-DS	P60-3/4-2	P60-CP
Walker	887	886	895T	896TCK	895(pwr), 896CK (tel/data)
Hubbell	B2536	B2527	S3925	S2525	S3082

- 3. Box Type B: For slab on grade: single-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box. For slab above grade: single-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

<u>MFR</u>	<u>CAST IRON BOX</u>	<u>STAMPED STEEL BOX</u>	<u>COVER PLATE (POWER)</u>	<u>COVER PLATE (TEL/DATA)</u>	<u>CARPET TRIM</u>

Steel City	641	N/A	P64-DS	P64-3/4-2	P64-CP
Walker	880CS1	880S1	828R	829CK-3/4	817C, 817T (for tile)
Hubbell	B2436	B2431	S3825	S2425	SB-3083

4. Box Type C: For slab on grade: two-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: two-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

<u>MFR</u>	<u>CAST IRON BOX</u>	<u>STAMPED STEEL BOX</u>	<u>COVER PLATE (POWER)</u>	<u>COVER PLATE (TEL/DATA)</u>	<u>CARPET TRIM</u>
Steel City	642	N/A	P64-DS	P64-3/4-2	P64-2G-CP
Walker	880CS2	880S2	828R	829CK-3/4	827C, 827T (for tile)
Hubbell	B4233	B2432	S3825	S2425	SB-3084

5. Box Type D: For slab on grade: three-gang, rectangular, watertight, Class 1, fully adjustable, cast iron box with removable partition. For slab above grade: three-gang, rectangular, concrete-tight, fully adjustable, stamped galvanized steel box. Brass cover plate and brass carpet ring. Provide aluminum cover plate and trim in lieu of brass when directed by Architect. Provide shallow boxes where necessitated by slab depth.

<u>MFR</u>	<u>CAST IRON BOX</u>	<u>STAMPED STEEL BOX</u>	<u>COVER PLATE (POWER)</u>	<u>COVER PLATE (TEL/DATA)</u>	<u>CARPET TRIM</u>
Steel City	643	N/A	P64-DS	P64-3/4-2	P64-3G-CP
Walker	880CS3	880S3	828R	829CK-3/4	837C, 837T (for tile)
Hubbell	B4333	B2433	S3825	S2425	SB-3085

6. For Multi-service Floor Boxes, see Division 26/27 Section “Common Work Results for Communications”.

E. Fire-Rated Poke-Through Outlets – TYPE A Single Service

1. UL listed and UL Fire Classified, flush or pedestal type as indicated on the Drawings, with one- to four-hour fire rating, as required by floor rating and type.
2. Flush type:
 - a. Single-service type: Capable of supporting, at a minimum, a duplex 20A/125V receptacle (or equivalent).
 - b. Furniture-feed type: Single-service type as indicated on the Drawings.
 - c. Cover plate, with individual device covers, and floor flange, UL514A listed for scrub water exclusion.
 - d. Color: As directed by the Architect.
3. Service Pedestal type:
 - a. Single-service type: single-, two-, four-, six-, or eight-gang, with quantities and types of devices as indicated on the Drawings.
 - b. Housing: As directed by the Architect.
4. For additional poke-through types, see Division 26/27 Section “Common Work Results for Communications”.

F. Cabinets and Enclosures

1. General:
 - a. Compliance: NEMA 250; UL 50 and 508A, as applicable.

- b. NEMA Type 1: Code-gauge phosphatized steel with continuously welded seams; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed removable hinged front cover, with flush keyed latch and concealed hinge; collar studs.
- c. [NEMA Type 12: Code-gauge phosphatized steel with continuously welded seams; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; external wall-mounting brackets; rolled flanges on door and door opening; continuous-hinged door, with removable steel pin; oil-resistant continuous gasket; hasp and staple for padlocking; collar studs; captive, plated steel door clamps; interior data pocket.]
- d. NEMA Type 3R: Code-gauge galvanized steel with drip shield top, seam-free front, side, and back; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed continuous-hinged door, with stainless steel pin; captive, plated steel cover screws; hasp and staple for padlocking; collar studs.
- e. [NEMA Type 4X: External wall-mounting brackets; rolled flanges on door and door opening; continuous-hinged door, with removable stainless steel pin; seamless continuous gasket; stainless steel hasp and staple for padlocking; collar studs; captive, stainless steel door clamps on 3 sides of door; interior data pocket:
 - 1) Metal: Code-gauge Type 304 stainless steel with continuously welded seams.
 - 2) Nonmetallic: Fiberglass-reinforced Plastic (FRP) with continuously sealed seams; finished inside with radio-frequency-resistant paint.]
- f. Removable painted steel interior panel mounted on standoffs; metal barriers to separate wiring of different systems and voltages.
- g. Where keyed locks are indicated, provide 2 keys for each enclosure, with all locks keyed alike.
- h. Provide enclosures wider than 36 inches with double doors; removable center posts; internal bracing, supports, or both, as required to maintain their structural integrity; and, accessory feet where required for freestanding equipment.
- i. Provide clamps, grids, slotted wireways, or similar devices to which or by which wiring may be secured. Provide DIN-rail mounted terminal strips for terminating all incoming and outgoing control wiring, and power terminal blocks for incoming/outgoing power wiring.
- j. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power and higher-voltage control wiring.

2.4 FACTORY FINISHES

- A. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAYS

- A. General
 - 1. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this article are stricter.
 - 2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 1/2 inch (concealed and exposed); 1 inch (underground and under slab).
 - 3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.

4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
5. Install grounding bushings on all conduit terminations and bond to the enclosure, equipment grounding conductor, and electrical system ground.
6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Architect, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
8. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
9. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
10. Install raceways:
 - a. To meet the requirements of the structure and the requirements of all other Work on the Project.
 - b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
 - c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
 - d. Parallel or perpendicular to building lines or column lines.
 - e. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
11. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - b. Space raceways laterally to prevent voids in concrete.
 - c. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - d. Change from RNC to coated GRS or IMC before rising above the floor.
12. Where masonry walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
13. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section "Hangers and Supports for Electrical Systems", and per Division 26 Section "Vibration and Seismic Controls for Electrical Systems" and per Division 23 Section, "Seismic Controls for HVAC Piping and Equipment". Do not support raceways by hangers used for any other systems foreign to the electrical systems; and, do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.
14. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:
 - a. Attach single raceway directly to structural steel with beam clamps.
 - b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
 - c. Attach groups of raceway to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
 - d. Attach groups of raceway to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
 - e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.

- f. Hang horizontally suspended groups of raceway using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
 - g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
 - h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
 - i. Use pre-fabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.
15. Install electrically- and physically-continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.
 16. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Architect's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
 17. Align and install raceway terminations true and plumb.
 18. Complete raceway installation before starting conductor installation.
 19. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
 20. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
 21. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Architect, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Architect, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.
 22. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.
 - b. Where otherwise required by NFPA 70.
 23. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with as indicated; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

B. RMC

1. Use GRS or IMC in the following areas:
 - a. Where indicated.
 - b. Exterior applications where above grade and exposed.
 - c. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
 - d. All raceways penetrating slabs on grade (use plastic-coated raceway or provide with a corrosion resistant approved mastic coating). This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.
2. Use RAC in the following areas:
 - a. Indoors above grade.
 - b. Interior wet or damp locations.
 - c. For circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
3. Do not use RAC:
 - a. Below grade.

- b. Imbedded in concrete or other areas corrosive to RAC.
- C. EMT
 - 1. Use EMT in the following areas:
 - a. Where indicated.
 - b. Interior concealed locations for:
 - 1) Branch and feeder circuits.
 - 2) Low-voltage control, security, and fire alarm circuits
 - 2. Do not use EMT:
 - a. Below grade.
 - b. In exterior applications when exposed.
- D. FMC and LFMC
 - 1. Use FMC or LFMC:
 - a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
 - b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.
 - 2. Do not use FMC or LFMC:
 - a. For branch circuits, homeruns or feeders.
 - b. <Insert additional locations>
 - 3. Use FMC only in dry locations; use LFMC in damp, wet, corrosive, and outdoor locations.
- E. RNC
 - 1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.
 - 2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per Article 352.44 of NFPA 70, to accommodate thermal expansion in straight runs.
 - 3. Use RNC in the following locations:
 - a. Only where specifically indicated, and then only as specified below.
 - b. Underground, single and grouped, in lieu of GRS or IMC, when indicated.
 - 1) Direct buried
 - 2) Concrete-encased (use approved rigid PVC interlocking spacers, selected to provide minimum duct spacing and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts).
 - 4. Do not use RNC:
 - a. Exposed indoors
 - b. In occupied spaces.
 - c. In return air plenums.
 - d. Where subject to physical damage.
 - e. Where not permitted by codes.
- F. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.
 - 3. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 4. Use insulating bushings to protect conductors at raceway terminations:
 - a. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.

- b. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- G. Telephone and Signal/Data System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- H. Wireways
 - 1. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.
 - 2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
 - 3. Close ends of wireway and unused raceway openings.

3.2 BOXES

A. General

- 1. Verify locations of device boxes prior to rough in.
- 2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
- 3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
- 4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
- 5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
- 6. Support boxes independently of raceway.
- 7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
- 8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
- 9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
- 10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.

B. Outlet Boxes

- 1. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes.
- 2. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Architect. Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.
- 3. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
- 4. Install extension and plaster rings as required by NFPA 70.
- 5. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
- 6. Do not exceed allowable fill per NFPA 70.
- 7. Where multiple devices are shown grouped together, gang mount with a common cover plate.

C. Junction and Pull Boxes

- 1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
- 2. Provide boxes set flush in painted walls or ceilings with primer coated cover.

3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.
4. Boxes for exterior use shall be:
 - a. PVC with a UV-stabilized PVC cover sealed and gasketed watertight.
 - b. Cast aluminum with a cast aluminum cover sealed and gasketed watertight.
 - c. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
 - d. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.

D. Floor Boxes

1. Use cast or non-metallic floor boxes for installations in slab on grade. Unless otherwise indicated, formed steel boxes are acceptable for slabs above grade.
2. Set metal floor boxes level and flush with finished floor surface.
3. Set non-metallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 CABINETS AND ENCLOSURES

- A. Unless otherwise indicated on the Drawings, provide NEMA 1 construction for indoor, dry locations; NEMA 12 for indoor, damp and dusty locations; NEMA 3R for outdoor locations; NEMA 4X for indoor wet and corrosive locations.
- B. Install flush mounted in the wall in finished spaces, with the top 78 inches above finished floor. The front shall be approximately 3/4-inch larger than the box all around.
- C. Install surface mounted in unfinished spaces, with the top 78 inches above finished floor. The front shall be the same height and width as the box.
- D. Electrically ground all metallic cabinets and enclosures. Where wiring to cabinet or enclosure includes a grounding conductor, provide a grounding lug in the interior of the cabinet or enclosure. Cabinets and enclosures specified in this Section are intended to house miscellaneous electrical components assembled in a custom arrangement, such as contactors and relays.
- E. All components that are specified or indicated for assembly in cabinets and enclosures shall each be individually UL listed and labeled. Arrange wiring so that it can be readily identified. Support wiring no less than every 3 inches. Install gauges, meters, pilot lights and controls on the face of the door.
- F. Do not provide cabinets and enclosures smaller than the sizes indicated. Where sizes and types are not indicated, provide cabinets and enclosures of the size, type and classes appropriate for the use and location per the guidelines of the NEC. Provide all items complete with covers and accessories required for the intended use.

END OF SECTION

SECTION 16135 (260536) – CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cable trays and accessories for the following types:
 - 1. Steel
 - 2. Aluminum
 - 3. Stainless-steel
 - 4. Fiberglass

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the arrangement of cable tray and supports with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others. Coordinate the work with other trades to avoid installation of obstructions within cable tray required clearances.
- B. Coordinate arrangement of cable tray with the dimensions and clearance requirements of the actual products to be installed.
- C. Coordinate the work with placement of supports, anchors, etc. required for mounting.
- D. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- E. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
- F. Cables shall not be installed within cable trays until associated raceway and cable tray system is complete.
- G. SUBMITTALS
- H. Product Data: Include data indicating dimensions, accessories and finishes for each type of cable tray indicated.
 - 1. Fiberglass Cable Tray Systems: Include requirements for strength derating according to ambient temperature.
- I. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- J. Coordination Drawings: Floor and reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Dimensioned cable tray routing; including offsets, cable access and clearances. Include fittings for attachment to electrical equipment.
 - 2. Location of structural supports cable tray systems and seismic bracing.

- 3. Location and elevations of structural members, light fixtures, sprinkler piping and heads, HVAC equipment, ducts and diffusers, plumbing piping and access fittings. Include maintenance access clearances.
 - K. Derating Calculations for Fiberglass Cable Tray Systems: Indicate span/load ratings adjusted for applicable service conditions.
 - L. Field quality-control reports.
 - M. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record actual cable tray routing and locations of supports.
 - N. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.
- 1.3 QUALITY ASSURANCE
- A. Source Limitations: Obtain cable tray system and associated components and accessories through one source from a single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NFPA 70.
- 1.4 SEISMIC REQUIREMENTS
- A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 20 Section "Seismic Controls for MEP/F/T Systems".
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.
 - B. Handle products carefully to avoid damage to finish.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide cable tray system to meet span/load ratings in accordance with NEMA VE 1 for metal cable tray systems, or NEMA FG 1 for fiberglass cable tray systems, with safety factor of 1.5 and working load. Account for additional concentrated static loads at supports where required and allowed per NFPA 70.

- D. Unless otherwise indicated, specified widths and loading depths are nominal values according to NEMA VE 1 for metal cable tray systems or NEMA FG 1 for fiberglass cable tray systems with applicable allowable tolerances.

2.2 MANUFACTURERS

- A. [Available] Manufacturers: Subject to compliance with requirements, provide products by one of the following
 1. ABB, Inc.
 2. Cablofil, a brand of Legrand North America, Inc.
 3. Chalfant Manufacturing Company.
 4. Cooper B-Line; Eaton.
 5. Cope; a division of Atkore International.
 6. Enduro Composites
 7. Mono-Systems; Niedax Group
 8. MPHusky.

2.3 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
 1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
- B. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with chromium-zinc, ASTM F 1136splice-plate fasteners, bolts, and screws.
- C. Cable Trays, Fittings, and Accessories: Stainless steel, Type 304 or 316, complying with NEMA VE 1.
- D. Cable Trays, Fittings, and Accessories: Polyester or vinyl resin fiberglass, complying with NEMA FG 1 and UL 568. Splice-plate fasteners, bolts, and screws shall be fiberglass-encapsulated stainless steel. Design fasteners so that no metal is visible when fully assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.
 1. Flammability: Fire retardant with NFPA 101, Class A flame spread index when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- E. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
 1. Center-hanger supports may be used only when specifically indicated.

2.4 CABLE TRAY TYPE

- A. Basket Cable Trays: Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in 10 foot lengths.
- B. Ventilated Trough Cable Trays:
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in 10 or 20 foot lengths.
 3. Fixed rung spacing shall 4 inches on center.
- C. Ladder Cable Trays:
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in 10 or 20 foot lengths.

3. Rung spacing of 9 inches.
- D. Channel Cable Trays: One-piece construction. Slot spacing shall not exceed 4-1/2 inches o.c.
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in 10 or 20 foot lengths.
- E. Solid-Bottom Cable Trays: One-piece construction. Provide with solid covers.
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in of 10 or 20 foot lengths.
- F. Single Rail Cable Tray: Center rails and rungs with continuous square tube rungs with radius corners. Splice hangers shall be capable of acting as the support points for all-thread rod.
 1. Cable tray width and loading depth shall be as indicated on drawings.
 2. Straight sections shall be supplied in 10 foot lengths.
 3. Rungs shall be spaced every 9 inches.

2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Louvered type of same materials and finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as cable tray; with supports sufficient to resist cable pulling weight applied during installation.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 SOURCE QUALITY CONTROL

- A. Perform factory design and production tests according to NEMA VE 1 for metal cable tray systems or NEMA FG 1 for fiberglass cable tray systems.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Verify that conditions are satisfactory for installation prior to starting work.
- B. Install in accordance with manufacturer's instructions.

3.2 CABLE TRAY INSTALLATION

- A. Modifications to Existing Cable Tray Systems: Remove inactive or abandoned cables from existing cable tray system.
- B. Remove burrs and sharp edges from cable trays.
- C. Install cable tray in accordance with NECA 1 and comply with recommendations in NEMA VE 2].
- D. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

- E. Arrange cable tray to provide required clearances and maintain cable access.
 - 1. Minimum Clearance Above and Adjacent to Cable Tray: 12 inches.
 - 2. Cable Tray for Telecommunications Cables: Maintain recommended separation from sources of EMI greater than 5 kVA in accordance with NECA/BICSI 568.

- F. Fasten cable tray supports to building structure.
 - 1. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
 - 2. Place supports so that spans do not exceed maximum spans limits set by the manufacturer.
 - 3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - 4. Support bus assembly to prevent twisting from eccentric loading.
 - 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - 6. Locate and install supports according to NEMA VE 1 for metal cable tray systems or NEMA FG 1 for fiberglass cable tray systems.
 - 7. Install seismic restraints where required in accordance with Division 20 section "Seismic Controls for MEPFT"

- G. Cable Tray Movement Provisions:
 - 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
 - a. Where cable tray crosses structural joints intended for expansion.
 - b. Long straight cable tray runs in accordance with NEMA VE 2.
 - c. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
 - d. Set gaps for expansion fittings in accordance with NEMA VE 2.

- H. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

- I. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in to NEMA VE 1 for metal cable tray systems or NEMA FG 1 for fiberglass cable tray systems. Space connectors and set gaps according to applicable standard.

- J. Make changes in direction and elevation using standard fittings.

- K. Make cable tray connections using standard fittings.

- L. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

- M. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

- N. Workspace: Install cable trays with enough space to permit access for installing cables.

- O. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5,000, and 15,000 Volts.

- P. Provide end closures at unconnected ends of cable tray runs.

- Q. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.3 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- D. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
- E. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
- F. Install covers after installation of cable is completed.

3.4 WARNING SIGNS

- A. Legend: "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

3.5 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions and comply with NEMA VE 2 where more stringent.
- B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70. Refer to Division 26 section "Grounding and Bonding for Electrical Systems" for additional requirements.

3.6 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 - 1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 - 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 - 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.7 PROTECTION

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION

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SECTION 16155 (260543) – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes:
 - 1. Raceways, fittings, boxes, handholes, and manholes for direct buried and concrete-encased electrical distribution.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section "Common Work Results for Electrical” for limited scope general construction materials and methods.
- C. Division 26 Section “Grounding and bonding”
- D. Division 26 Section "Identification for Electrical Systems”

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Product data for the following products:
 - a. Raceways, Raceway fittings, separators, duct-bank materials, manholes, handholes, boxes, solvent cement, warning tape and warning planks.
 - 2. Shop drawings for:
 - a. Detailing fabrication and installation for custom manholes or handholes including duct entry provisions, reinforcing details, frame and cover design, manhole frame support rings, ladder details, grounding details, sump details, joint details, and cable racks, pulling irons, lifting irons.
- B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Accurately record actual routing of all exterior buried raceway including coordination with other surrounding utilities and underground structures. Provide scaled plans and sections that Indicate dimensions from finished grade or other fixed structural elements.

1.4 DEFINITIONS

- A. Terminology used in this specification is as defined below:
 - 1. GRS: Galvanized Rigid Steel Conduit
 - 2. RMC: Rigid Metal Conduit
 - 3. RNC: Rigid Nonmetallic Conduit

1.5 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

- B. Electrical Components, Devices, and Accessories:
 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 2. Marked for intended use.
- C. Comply with NFPA 70 and ANSI C2.
- D. Test and inspect pre-cast concrete utility structures according to ASTM C 1037.
- E. Non-concrete Handhold and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by a independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to project site with ends capped and store nonmetallic ducts with supports to prevent bending, warping, and deformation.
- B. Store pre-cast and other factory –fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings, if present, are visible.
- C. Lift and support pre-cast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

- A. Interruption of existing electrical service to occupied facilities shall not occur unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated.
 1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Architects written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manhole, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Architect.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 RACEWAYS AND FITTINGS

A. Metal Conduit

1. Manufacturers:
 - a. AFC Cable Systems, Inc.
 - b. Alflex Corporation, a Southwire Company
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Electri-Flex Co.
 - e. Indalex
 - f. Manhattan/CDT/Cole-Flex
 - g. O-Z/Gedney; Unit of General Signal (Fittings)
 - h. Republic Raceway
 - i. Tyco International; Allied Tube & Conduit Div.
 - j. Wheatland Tube Co.
2. RMC:
 - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6
3. Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.40 inches (1 mm), minimum.
4. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

1. Manufacturers:
 - a. AFC Cable Systems, Inc. (Tubing)
 - b. American International.
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Arnco Corp.
 - e. Cantex Inc.
 - f. Certaineed Corp.; Pipe & Plastics Group.
 - g. Condux International.
 - h. ElecSYS, Inc.
 - i. Electri-Flex Co.
 - j. Lamson & Sessions; Carlon Electrical Products.
 - k. Manhattan/CDT/Cole-Flex.
 - l. RACO; Division of Hubbell, Inc.
 - m. Spiralduct, Inc./AFC Cable Systems, Inc.
 - n. Superflex Ltd.
 - o. Thomas & Betts Corporation.
2. RNC: Schedule 40 (type EPC-40-PVC) PVC: NEMA TC 2, UL 651.
 - a. a.Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. DUCT ACCESSORIES

1. Duct Separators shall be factory-fabricated rigid interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

3. Concrete warning planks shall be nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Labeling: Mark each plank with "ELECTRICAL" in 2-inch high, 3/8-inch deep letters.

2.3 PRE-CAST CONCRETE HANDHOLES AND BOXES

A. General

1. Manufacturers:
 - a. Carder Concrete Products.
 - b. Christy Concrete Products
 - c. Elmhurst-Chicago Stone Co.
 - d. Oldcastle Pre-cast Group
 - e. Riverton Concrete Products; a division of Cretex Companies, Inc.
 - f. Utility Concrete Products, LLC
 - g. Utility Vault Co.
 - h. Wausau Title, Inc.

B. Comply with ASTM C858 for design and manufacturing process.

C. Pre-cast concrete handholes and boxes shall be factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of the handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
4. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
5. The cover finish shall be a nonskid finish with a minimum coefficient of friction of 0.50.
6. The cover shall have the following legend lettering molded into the cover:
 - a. "C.A.T.V."
 - b. "COMMUNICATIONS"
 - c. "ELECTRICAL"
 - d. "FIBER OPTICS"
 - e. "LIGHTING"
7. Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
8. Extensions and slabs shall be designed to mate with bottom of enclosure and shall be same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab shall be same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows shall be included as pre-cast openings in walls arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.

- b. Window openings shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.
10. Duct entrances into handhole walls shall have cast end-bell or duct-terminating fittings in the wall for each entering duct.
- a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE

A. General

1. Description: Comply with SCTE 77.
2. Color of Frame and Cover: Gray where installed in concrete or other paved area; Green where installed in grass area.
3. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
4. Load Ratings:
 - a. Boxes and covers installed in sidewalks and other areas not subject to normal vehicular traffic shall be rated for a design load of 8,000 lbs. minimum.
 - b. Boxes and covers installed in driveways, parking lots, and other off-roadway applications shall be rated for a design load of 15,000 lbs. minimum.
 - c. Boxes and covers installed in roadways and other high vehicular traffic areas shall be rated for a design load of 28,800 lbs.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, applicable logo from the following:
 - a. "C.A.T.V"
 - b. "COMMUNICATIONS"
 - c. "ELECTRIC"
 - d. "FIBER OPTICS"
 - e. "LIGHTING"
8. Duct Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pullin-in irons.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Strongwell

C. Fiberglass Handholes and Boxes with Polymer-Concrete frame and cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.

- c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
 - e.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
- E. High-Density Plastic Boxes: Injection molded of high-density polyethylene of copolymer-polypropylene. Cover shall be polymer concrete.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Nordic Fiberglass, Inc.
 - c. PenCell Plastics

2.5 PRE-CAST MANHOLES

- A. Pre-cast-concrete manholes shall be furnished in sizes as indicated on the plans and as specified herein. Pre-cast manholes shall be constructed of reinforced concrete, complete with all appurtenances and accessories required.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carder Concrete Products.
 - b. Christy Concrete Products.
 - c. Elmhurst-Chicago Stone Co.
 - d. Oldcastle Pre-cast Group.
 - e. Riverton Concrete Products; a division of Cretex Companies, Inc.
 - f. Utility concrete Products, LLC.
 - g. Utility Vault Co.
 - h. Wausau Tile, Inc.
- B. Comply with ASTM C858, with structural design loading as specified in Part 3 “Underground enclosure Application” and with interlocking mating sections, complete with accessories, hardware, and features.
- 1. Windows: Pre-cast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie into concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.
 - 2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.
- C. Concrete Knockout Panels: 1-1/2 to 32 inches thick, for future conduit entrance and sleeve for ground rod.

- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

- A. Description: underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for concrete entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C858 and with Division 03 Section "Cast-In-Place Concrete."

2.7 UTILITY STRUCTURE ACCESSORIES

- A. Utility structures shall be installed complete including accessories as listed below.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Bilco Company (The).
 - b. Campbell Foundry Company.
 - c. Carder Concrete Products
 - d. Christy Concrete Products.
 - e. East Jordan Iron Works, Inc.
 - f. Elmhurst-Chicago Stone Co.
 - g. McKinley Iron Works, Inc.
 - h. Neenah Foundry Company.
 - i. NewBasis
 - j. Oldcastle Precast Group
 - k. Osburn Associates, Inc.
 - l. Pennsylvania Insert Corporation.
 - m. Riverton concrete Products; a division of Cretex Companies, Inc.
 - n. Strongwell Corporation; Lenoir City Division.
 - o. Underground Devices, Inc.
 - p. Utility Vault Co.
 - q. Wausau Tile, Inc.
- B. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2 inch diameter eye, and 1 by 4 inch bolt.
 - 1. Working load embedded in 6 inch, 4000-psi concrete is 13,000-lbf maximum tension
- C. Pulling Eyes in Non-concrete Walls: Eyebolt with reinforced fastening, 1-1/4 inch diameter eye, rated 2500-lbf minimum tension.
- D. Pulling-In and Lifting Irons in Concrete Floors: 7/8 inch diameter, hot-dip galvanized, bent rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- E. Bolting Inserts for concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of non-corrosive, chemical-resistant, non-conductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000-lbf minimum.
- F. Expansion Anchors for Installation after Concrete is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

- G. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2 inch centers for cable-arm attachment.
 - 2. Arms: 1-1/2-inches wide, lengths ranging from 3-inches with 450-lb minimum capacity to 18-inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- H. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
 - 1. Stanchions: Nominal 36-inches high by 4-inches wide, with minimum of 9 holes for arm attachment.
 - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3-inches with 450-lb minimum capacity to 20-inches with 250-lb minimum capacity. Top of arm shall be nominally 4-inches wide, and shall have slots along length for cable ties.
- I. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- J. Cover Hooks: Heavy duty, design for lifts 60-lbf and greater] [Light duty, designed for lifts less than 60-lbf]. [Two] <Insert quantity> required.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables over 600 V: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600volts and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 volts and Less: RNC, NEMA Type EPC-40 PVC, in direct- buried duct bank, unless otherwise indicated.
- D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, indirect-buried duct bank, unless otherwise indicated.
- E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC, in concrete-encased or direct-buried duct bank, unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths Walks, Driveways [and] [Roadways: RNC, NEMA Type EPC-40 PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE INSTALLATION

- A. Handholes and Boxes for 600 volts and Less ,Including Telephone, Communications, and Data Wiring:
 - 1. Units in roadways and Other Deliberate Traffic Paths: Pre-cast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer Concrete, SCTE 77, Tier 15 structural load rating.

3. Units in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate loading by Vehicles: Polymer Concrete Units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced Polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- 5.

3.3 EARTHWORK

- A. Excavation and Backfilling: Comply with Division 31 Section "Earth Moving" but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling and compaction is complete.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses and "Plants"
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48-inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell with out reducing duct line slope and without forming a trap in the line.
 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and ducts to prevent

- floating during concreting. Stagger separators approximately 6-inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around the ducts or duct group.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to the manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install ¾-inch reinforcing rod dowels 18-inches into concrete on both sides of joint near corners of envelope.
 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured with out soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3-inches between ducts and exterior envelope wall, 2-inches between ducts for like services, and 4-inches between power and signal ducts.
 7. Depth: Install top of duct bank at least 24-inches below finished grade in areas not subject to deliberate traffic, and at least 30-inches below finished grade in deliberate traffic paths of vehicles, unless otherwise indicated.
 8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
 - b. Stub-ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3-inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional tapes 12-inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6-inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6-inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4-inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

6. Install ducts with a minimum of 3-inches between ducts for like services and 6-inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36-inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.

~~10. Warning Planks: Bury warning planks approximately 12 inches above all direct buried ducts in duct banks placing them 24 inches O.C. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12 inch increment of duct bank width over a nominal 48 inches. Space additional planks 12 inches apart, horizontally.~~

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for future duct connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Install handholes with bottom below the frost line, 36 inches below grade.
2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1-inch above grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

E. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

F. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "Elastomeric Sheet Waterproofing or Thermoplastic Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days

- G. Dampproofing: Apply dampproofing to exterior surfaces of handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07 Section "Bituminous Dampproofing". After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eye, cable stanchions, cable arms, and insulators, as required for installation and support of cable and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8-inches for manholes and 2-inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRE-CAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 36 inches below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10-inch wide by 12-inches deep.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 INSTALLATION ACCEPTANCE

- A. Prior to final acceptance of the duct bank and associated structures, pull an aluminum or wood test mandrel through the duct to prove joint integrity and to verify ducts have not been deformed. Provide mandrel equal to 80 percent fill of the duct. Test duct bank, manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems." Correct any deficiencies and retest as specified above. Clean internal surfaces of manholes (including sumps) and handholes and remove foreign materials.

END OF SECTION

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SECTION 16701 (260548) - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. This section includes general seismic requirements specific other sections of the Division 26 specifications.

1.2 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 SUMMARY

- A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 20 Section “Seismic Controls for MEP/F/T Systems”.
- B. The following equipment shall withstand the effects of earthquake motions. The equipment will remain in place without separation of any parts from the device when subjected to the seismic forces specified:
 - 1. Panelboards used in normal power systems
 - 2. Raceways and Boxes used in normal power systems
 - 3. Low-Voltage Transformers used in normal power systems
 - 4. Switchboards used in normal power systems
 - 5. Panelboards used in normal power systems
- C. In addition to the requirements above, the following equipment shall be fully operational after the seismic event:
 - 1. Panelboards used in emergency power systems
 - 2. Raceways and Boxes used in emergency power systems
 - 3. Low-Voltage Transformers used in emergency power systems
 - 4. Switchboards used in emergency power systems
 - 5. Panelboards used in emergency power systems

1.4 SUBMITTALS

- A. Provide submittals as required by Division 20 Section “Seismic Controls for MEP/F/T Systems” for all electrical systems specified herein.

END OF SECTION

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SECTION 16075 (260553) – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Nameplates.
 - 2. Labels for raceways and metal-clad cable.
 - 3. Labels for junction boxes and pull boxes.
 - 4. Labels for wiring devices and lighting control devices.
 - 5. Markers for conductors, and control cables.
 - 6. Tags.
 - 7. Underground-line warning tape.
 - 8. Warning labels and signs.
 - 9. Arc Flash Warning Labels.
 - 10. Instruction signs.
 - 11. Miscellaneous identification products.
 - 12. Painted Identification.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.
- B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- C. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- D. Coordinate installation of identifying devices with location of access panels and doors.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.

1.3 SUBMITTALS

- A. Product Data: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements” for each electrical identification product indicated:
 - 1. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
 - 2. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Electrical Equipment, Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- B. Comply with ANSI A13.1 and ANSI C2.

- C. Comply with requirements of NFPA 70.
- D. Comply with 29 CFR 1910.145.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Location, text, and method of identification to be used is noted in individual sections. Refer to other sections for additional identification requirements.

2.2 NAMEPLATES

- A. Engraved, Laminated Acrylic or Melamine Label: Non-conductive phenolic with beveled edges. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 1. Punched or drilled for screw mounting.
 - 2. Minimum 1/16 inch (1.6 mm) thick for nameplates with either dimension greater than 4 inches (102 mm) and 1/8 inch (3.2 mm) thick for larger sizes.
- B. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
- C. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text
- D. Colors:
 - 1. Normal systems - white letters on a black background.
 - 2. Emergency systems - white letters on a red background.

2.3 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

- A. Factory Painted Raceways:
 - 1. Metal Raceways: Continuous, rust-inhibiting paint factory applied.
 - 2. Non-Metallic Raceways: Factory dyed or colored PVC sleeve.
- B. Factory Painted Metal-Clad Cable: 2-inch wide, factory painted bands at a maximum of 6-foot on center spacing.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.4 LABELS FOR JUNCTION BOXES AND PULL BOXES

- A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

2.5 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

- A. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.
- B. Engraved, Laminated Acrylic or Melamine Label: adhesive backed. Minimum letter height shall be 3/16 inch (4.76 mm).
 - 1. Normal systems - white letters on a black background.
 - 2. Emergency systems - white letters on a red background
- C. Engraved cover plates: Provide with white letters. White or ivory cover plates shall have black letters.

2.6 MARKERS FOR CONDUCTOR AND CONTROL CABLES

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.
- D. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

2.7 TAGS

- A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.8 UNDERGROUND-LINE WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color: Tape for Buried Power Lines: Black text on red background.

2.9 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.
- B. Self-Adhesive Warning Labels: Factory pre-printed or machine-printed multicolor self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
 - 1. Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 2. Do not use labels designed to be completed using handwritten text.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
 - 1. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
 - 3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

2.10 ARC FLASH WARNING LABELS

- A. General: All labels will be based on recommended overcurrent device settings and will be printed after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system. Refer to Division 26 section "Overcurrent Protective Device Study" for additional requirements.
- B. Materials: Use machine-printed, high adhesion, polyester label; UV, chemical, water, heat, and abrasion resistant, for each work location analyzed.
- C. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer. Labels shall be machine printed, with no field markings. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
- D. Minimum Size: 3.5 inch by 5 inch (89 mm by 127 mm), unless otherwise noted by Owner.

- E. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment. The label shall include the following information, at a minimum:
1. Location designation
 2. Nominal voltage
 3. Available fault current
 4. Limited approach boundary
 5. Arc flash boundary
 6. Restricted approach boundary
 7. Hazard risk category
 8. Incident energy
 9. Working distance
 10. Site-specific PPE (personnel protective equipment) requirements.
 11. Date calculations were performed.
 12. Engineering report number, revision number and issue date.

2.11 INSTRUCTION SIGNS

- A. Engraved, Laminated Acrylic or Melamine plastic: Non-conductive phenolic. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.
1. Minimum 1/16 inch (1.6 mm) thick for nameplates with either dimension greater than 4 inches (102 mm) and 1/8 inch (3.2 mm) thick for larger sizes.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
 4. Normal systems: Engraved legend with white letters on black face.
 5. Essential Systems: Engraved legend with white letters on red face.
- B. Stainless Steel Nameplates: Minimum thickness of 1/32 inch ; engraved or laser-etched text.
- C. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text
- D. Colors:
1. General Information and Operating Instructions – Black letters on white background.
 2. Normal systems - white letters on a black background.
 3. Emergency systems - white letters on a red background.

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- B. Fasteners for Nameplates, Labels and Signs
1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.
- C. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.13 PAINTED IDENTIFICATION

- A. Paint materials and application requirements are specified in Division 09 painting Sections.
1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
 2. Exterior Concrete Unit Masonry:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
 3. Exterior Ferrous Metal:
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
 4. Exterior Zinc-Coated Metal (Except Raceways):
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.
 - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
 5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior concrete and masonry primer.
 - 2) Finish Coats: Interior semi-gloss alkyd enamel.
 6. Interior Concrete Unit Masonry:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
 7. Interior Gypsum Board:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
 8. Interior Ferrous Metal:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
 9. Interior Zinc-Coated Metal (Except Raceways):
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify identity of each item before installing identification products.
- B. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.
- C. Provide identification product listed for the location in which it is to be installed.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. For surfaces that require finish work, apply identification devices after completing finish work. Do not install identification products until final surface finishes and painting are complete.
- C. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed. Replace labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.
- D. Location: Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance without interference with operation and maintenance of equipment. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
 - 1. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- G. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.
 - 1. Indoor Clean, Dry Locations: Use plastic nameplates, unless noted otherwise.
 - 2. Outdoor Locations: Use plastic nameplates suitable for exterior use.
- H. Install identification products centered, level, and parallel with lines of item being identified.
- I. Mark all handwritten text, where permitted, to be neat and legible.
- J. For refrigeration systems: Neatly bundle circuits and clearly tag and label each circuit with panelboard, branch circuit designation and refrigeration system number at each termination.

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SECTION 16055 (260573) – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes computer-based studies for the following:
 - 1. Short-circuit analysis.
 - 2. Protective device coordination study.
 - 3. Arc flash and shock risk assessment, including arc flash hazard labels.
- B. Criteria for selection and adjustment of equipment and associated protective devices not specified in this section, as determined by the studies performed.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the short-circuit study. Device ratings for furnished equipment shall be as required by the results of the short-circuit study at no additional cost.
- B. Coordination:
 - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
 - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 3. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.
- D. Sequencing:
 - 1. Initial Study:
 - a. Study must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. Do not order equipment until matching study reports and product submittals have both been evaluated by the Contract Administrator.
 - b. If study has not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the Contractor at no additional cost to the project.
 - 2. Final Study:
 - a. Study must be completed and submitted for review prior to substantial completion. Do not print arc flash labels until final study has been evaluated by the Contract Administrator.
 - b. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels.
- E. Scheduling:
 - 1. Arrange access to existing facility for data collection with Owner.
 - 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner. Refer to Division 26 section “General Electrical Requirements” for additional requirements.

1.3 SUBMITTALS

- A. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Product data for computer software program to be used for studies.
 - 2. Include characteristic time-current trip curves for protective devices.
 - 3. Include impedance data for busway.
 - 4. Include impedance data for engine generators.
 - 5. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 6. Include documentation of listed series ratings upon request.
 - 7. Identify modifications made in accordance with studies to meet the results of the study.
- B. [Electronic files, in an SKM-compatible format, of the time-current characteristic curves for every different overcurrent device used in the reports.]
- C. Product Certificates: For coordination-study and short-circuit-study computer software programs, certifying compliance with IEEE 399.
- D. Qualification Data:
 - 1. Study Preparer Specialist qualifications.
 - 2. Field Testing Agency qualifications.
- E. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- F. Other Action Submittals:
 - 1. Initial Study report, stamped or sealed and signed by study preparer, including:
 - a. Cover page including date of study, study methodology, assumptions made and software products used.
 - b. Study input data, including completed computer program input data sheets.
 - c. Short-circuit study report.
 - d. Equipment evaluation report.
 - e. Coordination-study report.
 - f. Settings report.
 - 2. Final Study report, stamped or sealed and signed by study preparer, including:
 - a. Cover page including date of study, study methodology, assumptions made, software products used, and summary of changes between initial and final studies.
 - b. Study input data, including completed computer program input data sheets.
 - c. Short circuit study report.
 - d. Equipment evaluation report.
 - e. Coordination-study report.
 - f. Settings report.
 - g. Arc-Flash Hazard Analysis, including labels.
 - 3. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- G. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

3. Include copies of previous studies and existing drawings that were obtained during the data collection phase of the study.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Study Preparer Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Professional engineer, licensed in the state in which the Project is located, shall be responsible for the study and with a minimum five years experience in the preparation of studies of similar type and complexity using the specified computer software. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 399 for general study procedures.
- D. Comply with IEEE 141, 242 and 551 for short-circuit currents and coordination time intervals.
- E. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard calculations.
- F. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
 1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

PART 2 - PRODUCTS AND MATERIALS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, use the latest commercially available computer software programs utilizing the specified methodologies developed by one of the following:
 1. SKM Systems Analysis, Inc.
- C. Computer Software Developer: Subject to compliance with requirements, use the latest commercially available computer software programs utilizing the specified methodologies developed by <Insert computer software developer's name>.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of short-circuit-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.

1. Zero-Sequence current.
2. Arcing faults.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.
- C. Short-circuit study and coordination study to be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that correct equipment gets ordered for the project conditions.
- D. Arc Flash Study must be performed after conductors and equipment have been installed and after the project's utility company confirms the available fault current. A final short-circuit and coordination study with all device settings shall be submitted with the Arc Flash Study. The goal of the revised settings is to minimize the arc flash hazard while maintaining reasonable coordination and selectivity. For the components of emergency and legally required standby system components, full selectivity must be maintained.

3.2 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

- A. Study shall begin with the utility and each alternate power source overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device. This includes studies of the complete paths and operating modes on both sides of any transfer switch, contactor or circuit breaker.
- B. Operating modes shall include, where applicable:
 1. Utility as a source.
 2. Generator as a source.
 3. Utility and generator in parallel.
 4. Bus tie breaker open/close positions.
 5. Maintenance settings.
- C. Components include, but are not limited to:
 - 1.
 2. Switchboards
 3. Distribution Panelboards
 4. Panelboards
 5. Air Handling Equipment
 6. Roof Top HVAC equipment
 7. Elevator controllers

3.3 POWER SYSTEM DATA FOR STUDIES

- A. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling. Gather and tabulate the following input data to support studies:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:
 - a. Indicate load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
 - b. Protective Devices: Include circuit-breaker and fuse-current ratings and types;
 - c. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio. kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - e. Generators: Include manufacturer/model, kilovolt amperes, size, voltage, and source impedance.
 - f. Cables: Indicate conduit material, sizes of conductors, conductor insulation, and length.
 - g. Busways: Include bus material, ampacity and impedance.
 - h. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Magnetic inrush current overload capabilities of transformers.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Ratings, types, and settings of utility company's overcurrent protective devices.
 - e. Special overcurrent protective device settings or types stipulated by utility company.
 - f. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.
5. Existing Installations:
 - a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
 - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.

3.4 SHORT-CIRCUIT STUDY

- A. Source Impedance: As an infinite bus on primary side of utility transformer.

- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operation modes that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
 - 1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
 - 2. Low-Voltage Fuses: IEEE C37.46.
 - 3. Circuit Breakers: IEEE C37.13.
- F. Study Report:
 - 1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- and high-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
 - 3. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault current values for 3-phase, 2-phase, and phase-to-ground faults.
- G. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing short-circuit current ratings of these devices with calculated short-circuit current momentary and interrupting duties. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

3.5 COORDINATION STUDY

- A. Perform coordination study and prepare a written report using the results of the short-circuit study and approved computer software program. Comply with IEEE 399.
- B. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.
- C. Comply with IEEE 241 recommendations for fault currents and time intervals.
- D. Analyze alternate scenarios considering known operating modes.
- E. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.
- F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

- H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve the level of selective coordination required in the contract documents or by the edition of the National Electrical Code (including any local jurisdiction amendments) the project must comply with. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:
 - a. For protective Devices:
 - 1) Device tags.
 - 2) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 3) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
 - 4) Include ground fault pickup and delay.
 - 5) Include fuse ratings.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Generator full load current, overload curves, decrement curves and short-circuit withstand points.
 - g. Transformer inrush points.
 - h. Maximum fault current cutoff point.
 - i. Capacitor full load current and damage curves.
 3. Include conclusions and recommendations.
 4. Completed data sheets for setting of overcurrent protective devices.
 5. For emergency, legally required standby and health care essential power systems, such systems must selectively coordinate to the values indicated below unless local amendments to the National Electrical Code require a different value.
 - a. Emergency (NEC article 700) 0.01 seconds
 - b. Legally Required Standby (NEC article 701) 0.01 seconds

3.6 ARC-FLASH HAZARD ANALYSIS

- A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies in accordance with IEEE 1584. Perform the analysis under worst-case arc-flash conditions for all modes of operation.
- B. In addition to the requirements outlined in IEEE 1584, the study shall include all equipment rated less than 240 Volts fed by transformers less than 125 kVA in the calculations.
 1. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
 2. For single-phase systems, the calculations may be performed assuming a three-phase system in accordance with IEEE 1584, yielding conservative results.
- C. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
- D. Identify all locations and equipment to be included in the arc-flash hazard analysis:

1. Include a copy of the facility one-line in the report.
2. Identify the possible system operating modes including tie-breaker positions, and parallel generation.
3. Calculate the arcing fault current flowing through each branch for each fault location.
4. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
5. Select the working distances based on system voltage and equipment class.
6. Calculate the incident energy at each fault location at the prescribed working distance.
7. Determine the hazard/risk category (HRC) for the estimated incident energy.
8. Calculate the flash protection boundary at each fault location.
9. Document the assessment in reports and one-line diagrams.
10. Provide labels to be placed on each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.

E. Results of the arc-flash study shall be summarized in a final report containing the following:

1. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
2. Tabulations of the data used to model the system components and a corresponding one-line diagram.
3. Descriptions of the modes of operation evaluated and identification of the worst case scenario used to evaluate equipment ratings.
4. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
5. Required arc-flash labeling and placement of labels.
6. Conclusions and recommendations, including recommendations for reducing incident energy at locations where calculated maximum incident energy exceeds 8 calories per sq cm.

3.7 OVERCURRENT PROTECTIVE DEVICE SETTING

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to set overcurrent protective devices within equipment.
1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
 - a. Verify that overcurrent protective devices meet parameters used in studies.
 - b. Adjust devices to values listed in final study results.
 - c. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 100.7 and 100.8 in NETA ATS.

3.8 INSTALLATION

- A. Install arc flash warning labels. Refer to Division 26 section Identification for Electrical Systems for additional requirements.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
1. Inspect and test protective devices in accordance with the NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Overcurrent protection devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies protective device settings have been adjusted in accordance with the requirements of the study. Include notation of conflicts with or

deviations made from the studies or the contract documents, deficiencies detected, remedial action taken, and observations after remedial action.

3.10 TRAINING

- A. Provide training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
- B. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
- C. Provide minimum of eight hours of training performed by a representative of the entity performing the study.

END OF SECTION

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SECTION 16125 (260923) – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following lighting control devices:
 - 1. Line-voltage dimming wall switches.
 - 2. Line-voltage wall switch occupancy sensors.
 - 3. Line-voltage dimming wall switch occupancy sensors.
 - 4. Line-voltage occupancy sensors.
 - 5. Line-voltage photoelectric switches.
 - 6. Stand-Alone Low-voltage occupancy sensors.
 - 7. Stand-Alone Low-voltage photoelectric switches.
 - 8. Stand-Alone Low-voltage switches.
 - 9. Outdoor motion sensors.
 - 10. Time switches.
 - 11. Lighting contactors.
 - 12. Automatic load control relays.
 - 13. Branch circuit transfer switches.
 - 14. Conductors and Cables for Lighting Control Devices.

1.2 DEFINITIONS

- A. Closed loop: Photosensor control algorithm designed for influence by both daylight and electric light in a space or area.
- B. DPDT: Double pole, double throw.
- C. DPST: Double pole, single throw.
- D. Dual-Technology Type: Occupancy sensor detection type that detects occupancy by using a combination of PIR and ultrasonic or acoustic detection technologies.
- E. LED: Light-emitting diode.
- F. Open loop: Photosensor control algorithm designed for influence by daylight entering in a space or area.
- G. PIR Type: Passive infrared. Occupancy sensor detection type that detects occupancy by sensing a combination of infrared heat and movement.
- H. SPST: Single pole, single throw.
- I. Ultrasonic Type: Occupancy sensor detection type that detects occupancy by sensing a change in pattern of reflected ultrasonic energy.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.4 SUBMITTALS

- A. Product data for the following products:
 - 1. Catalog cut sheets, including major and minor motion coverage patterns sensors, time delay and sensitivity adjustability settings, load restrictions, and performance specification items indicating compliance with this specification for all lighting control devices.
 - 2. Documentation showing compliance with California Energy Commission certification.

- B. Shop Drawings:
 - 1. Occupancy sensors and photoelectric switches
 - a. Show installation details.
 - b. Lighting plan showing location, mounting height, orientation and coverage area of each sensor and coordination with other trades.
 - c. Interconnection diagrams showing field-installed wiring.
 - d. Include diagrams for power, signal, and control wiring.
 - e. For any manufacturer submitted other than that listed as the Basis of Design, provide the following information for Engineer review:
 - 1) Factory-generated occupancy sensor and photoelectric switch layouts on project lighting plans with sensor location, orientation and product type clearly marked on plans. Sensor placement shall be coordinated with project reflected ceiling plan layout, ceiling heights, lights, diffusers, and any other ceiling devices and equipment.
 - 2) List of any deviations to this specification or Basis of Design products.

- C. Field quality-control test reports.

- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. Occupancy sensors and photoelectric switches:
 - a. Manufacturer's installation instructions, including instructions for storage, handling, protection, examination, preparation, start-up calibration and installation.
 - b. Product data clearly showing sensor field adjustments, including dip switch setting definitions and location of settings within sensors.
 - c. Manufacturer's maintenance, including operating and adjustment instructions.
 - 2. Timeclocks
 - a. Description of programmed timeclock settings at time of substantial completion.
 - 3. Line-voltage wall box dimming switches
 - a. Provide operating instructions for each type of dimmer.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Occupancy sensors and photoelectric switches
 - 1. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of 5 years.
 - 2. Products shall be manufactured by an ISO 9001 certified manufacturing facility.
 - 3. Manufacturer shall test all equipment prior to shipment.

1.6 WARRANTY

- A. Manufacturers shall provide a five (5) year warranty for sensors and accessories from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

A. PIR type requirements:

1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
3. Sensor shall provide high immunity to false triggering from RFI and EMI.
4. Sensor shall have a multiple-segmented fresnel lens in a multiple-tier configuration, with grooves to eliminate dust and residue buildup. Sensor shall be capable of accepting mask inserts to mask specific portions of the lens to prevent false triggering.

B. Ultrasonic type requirements:

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHz within +/- 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk.
3. Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within +/- 0.005% tolerance, to assure reliable performance and eliminate sensor cross-talk.
4. Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.

C. Acoustic type requirements:

1. Detector Sensitivity: Acoustic type technology shall only be used as secondary to PIR in a Dual-Technology Type sensor. Specific sensitivity is based on PIR technology.
2. Sensors shall distinguish noises made by human activity (typing, talking, eating, etc.) and filter out noises made by the environment or building (HVAC, equipment, cars, etc.).
3. Acoustic technology shall enhance reliability and accuracy of PIR sensor.

D. Dual-Technology type requirements:

1. Dual-Technology sensors using ultrasonic technology shall have field-selectable controls on unit to determine if a particular technology or combination of technologies controls the on-off function.
2. Dual-Technology sensors using acoustic technology shall have the PIR technology initially detect motion and a combination of PIR and acoustic technologies shall keep the load on.
3. Sensitivity Adjustment: Separate for each sensing technology.
4. Different LED indicator colors for each sensing technology
5. PIR sensor component shall comply with all requirements listed under PIR type requirements.
6. Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type requirements.
7. Acoustic sensor component shall comply with all requirements listed under Acoustic Type requirements.

2.2 LINE-VOLTAGE DIMMING WALL SWITCHES

- #### A. Basis-of-Design Product:
- Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.

- B. Dimmer shall be suitable for dimmed load type of connected light fixture. Load types shall be as indicated on Drawings and confirmed per load type for connected luminaire as indicated in Light Fixture Schedule and approved light fixture and dimmer shop drawings.

2.3 LINE VOLTAGE WALL SWITCH OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. [Complies with California's Title 24 and is certified by the California Energy Commission.] Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C), unless indicated elsewhere for specific model and application.
 - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
 - 4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.
 - a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
 - b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of the switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
 - 5. Operation adjustment: Concealed, field-adjustable for auto-on or manual-on operation.
 - 6. Time Delay adjustment:
 - a. Concealed, field-adjustable.
 - b. Time delay for de-energizing loads shall be adjustable with multiple increments from 30 seconds up to 30 minutes.
 - 7. Adaptive technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - 8. Mounting: Single-gang wall box switch
 - 9. Finish: Sensor finish shall be as directed by the Architect.
 - 10. Sensor:
 - a. Vandal-resistant lens
 - b. Integral sliding blinders or pre-cut tape strips to block sensor views
 - c. Protrudes no greater than 0.50 inches from wall.
 - d. 180-degree field of view
 - e. Major and minor motion coverage patterns confirmed per Nema WD7 guidelines.
 - f. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
 - 11. Indicators:
 - a. LED indicator for visual detection of motion
 - b. audible and/or visual alerts for pending shut-off
 - 12. Suitable for switching load types used, including LED, fluorescent, incandescent, magnetic and electronic low voltage and motor load types. UL listed and labeled, zero-cross relay, no minimum load requirement, ground wire.
 - 13. Wall switch shall have no leakage of current to load and integral service switch to permit a maintained off for servicing of lamps for safety purposes
 - 14. Restriction on leakage to grounding conductor.
 - a. For new construction: Dual-technology wall switch sensor shall have not more than 0.5ma leakage of current to ground per UL requirements. Provide and connect a neutral conductor to these devices.

2.4 LINE-VOLTAGE DIMMING WALL SWITCH OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors:
 - 1. Comply with all requirements listed under Line-Voltage Dimming Wall Switches in this specification and,
 - 2. Comply with all requirements listed under Line-Voltage Wall Switch Occupancy Sensors in this specification.

2.5 LINE-VOLTAGE OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors. Integral relay unit for line voltage sensors.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. UL Listed for dry locations and complies with local codes.
 - 3. [Complies with California's Title 24 and is certified by the California Energy Commission.]
 - 4. Operation: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon occupancy of space, loads shall turn on. If occupancy is not detected within the time delay period, loads shall de-energize. Time delay for de-energizing loads shall be adjustable over a minimum range of 1 to 15 minutes with a maximum of 30 minutes.
 - 5. Switch Rating: As indicated in Lighting Control Device Schedule.
 - 6. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
 - 7. Mounting: Suitable for mounting in any position on a standard outlet box.
 - 8. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 9. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
 - 10. Bypass Switch: Override the "on" function in case of sensor failure, concealed on unit to prevent tampering.
 - 11. Finish: Sensor finish shall be as directed by the Architect.
 - 12. Operating temperatures: Unless indicated otherwise for specific models, 32 degree F through 104 degree F, and relative humidity of 0%-95%.
 - 13. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
 - 14. Device shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
 - 15. Device and related relays shall be compatible with the specific load types controlled.
 - 16. Sensor:
 - a. Coverage pattern: As indicated in Lighting Control Device Schedule, and shall have been confirmed with NEMA WD7 Guide and Robotic test method.
 - b. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
- C. High-Bay Model:
 - 1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.

2. Detection Coverage: Selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

2.6 LINE-VOLTAGE PHOTOELECTRIC SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. [Photoelectric switches shall Comply with California’s Title 24 and be certified by the California Energy Commission.]

2.7 STAND-ALONE LOW-VOLTAGE OCCUPANCY/VACANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensor unit, for use with a separate stand-alone low-voltage power pack containing a line-voltage relay.
 1. Occupancy sensors and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. UL Listed for dry locations and complies with local codes.
 4. [Complies with California’s Title 24 and is certified by the California Energy Commission.]
 5. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.
 - a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
 - b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of a separate, associated switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
 6. Switch Rating: As indicated in Lighting Control Device Schedule.
 7. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
 8. Mounting: Suitable for mounting in any position on a standard outlet box.
 9. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 10. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
 11. Bypass Switch: Override the “on” function in case of sensor failure, concealed on unit to prevent tampering.
 12. Finish: Sensor finish shall be as directed by the Architect.
 13. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.
 14. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
 15. Sensors:
 - a. Sensor shall be compatible with lighting control system.
 - b. Sensors shall be capable of being combined with additional sensors to achieve adequate coverage.
 - c. Sensor coverage pattern: AS indicated on Lighting Control Device Schedule, and shall have been confirmed with Nema WD7 Guide and Robotic test method.
 - d. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.

- C. High-Bay Model:
 1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
- D. Extreme Temperature Model:
 1. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
 2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.8 STAND-ALONE LOW-VOLTAGE PHOTOELECTRIC SWITCHES

- A. General Requirements for switches: Ceiling-mounted, solid-state indoor photoelectric switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
 1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. UL Listed for dry locations and complies with local codes.
 4. [Complies with California's Title 24 and is certified by the California Energy Commission.]
 5. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon ambient light level measurement reading below setpoint, loads shall be de-energized. Upon ambient light level measurement reading above setpoint, loads shall be energized.
 6. Finish: Sensor finish shall as directed by the Architect
- B. Indoor:
 1. [Photoelectric switches shall be as indicated on the Lighting Control Device Schedule on the Drawings
 2. Description: Solid state, low voltage with contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the lighting control system or as indicated on the Drawings.
 - a. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
 - b. Time Delay: 30-second minimum, to prevent false operation.
 - c. Mounting: Twist lock complying with IEEE C136.10, with base.
- C. Outdoor:
 1. Description: Solid state, low voltage with contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered [from the power pack][from the lighting control system][as indicated on the Drawings].
 - a. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
 - b. Time Delay: 30-second minimum, to prevent false operation.
 - c. Lightning Arrester: Air-gap type.
 - d. Mounting: Twist lock complying with IEEE C136.10, with base.

2.9 STAND-ALONE LOW-VOLTAGE POWER PACKS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for power packs: Box mounted, solid-state indoor power pack/relay unit, for use with a separate stand-alone low-voltage sensor and switches.

1. Power packs and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. UL Listed for dry locations and complies with local codes.
4. [Complies with California's Title 24 and is certified by the California Energy Commission.]
5. Unit shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
6. Relay shall be compatible with the specific lighting types controlled.
7. Operations: Refer to drawings for Sequence of Operations or other operational instructions. Unit operates in conjunction with other system components. Refer to operations requirements of associated devices.
8. Switch Rating: As indicated in Lighting Control Device Schedule.
Mounting: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
9. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.10 STAND-ALONE LOW-VOLTAGE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for switches: Wall-mounted, solid-state indoor manual switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
 1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. UL Listed for dry locations and complies with local codes.
 4. [Complies with California's Title 24 and is certified by the California Energy Commission.]
 5. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Manual push of any button shall energize or de-energize loads.
 6. Mounting: Suitable for mounting in any position on a standard outlet box.
 7. Indicator: LED, for each button to indicate when loads are energized and de-energized.
 8. Finish: Sensor finish shall be as directed by the Architect.
 9. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.11 OUTDOOR MOTION SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. [Complies with California's Title 24 and is certified by the California Energy Commission.]
 3. Weatherproof, detection technology as indicated in the Lighting Control Device Schedule on the Drawings.
 4. Detection type: PIR type. Refer to Section 2.1 General Information above for more information.
 5. Detection Coverage: As indicated in Lighting Control Device Schedule on the Drawings.

6. Switch Rating: Line Voltage: Minimum 1000-W incandescent and 500-VA ballast load at 120-V ac; 1000W ballast load at 277-V ac. Voltage as indicated on Drawings and Lighting Control Device Schedule.
7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 1 to 20 FC. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector with multiple increments from 30 seconds up to 15 minutes.
9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 14 to plus 130 deg F, rated as "rain tight" according to UL 773A.
10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box and ½” threaded nipple for use with standard NEMA weatherproof fixture fitting.
 - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Bypass Switch: Override the on function in case of sensor failure.

2.12 TIME SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Intermatic, Inc.
 3. Leviton Mfg. Company Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Paragon Electric Co.; Invensys Climate Controls.
 6. Square D; Schneider Electric.
 7. TORK; NSI Industries.
 8. Wattstopper; a Legrand Company.
- D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 1. Contact Configuration: SPST.
 2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
 3. Program: 2 channels; each channel shall be individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
 4. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric switch relay as substitute for on-off function of a program.
 6. Astronomic Time: All channels.
 7. Battery Backup: For schedules and time clock.
- E. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 1. Contact Configuration: [SPST] [DPST] [DPDT] <Insert configuration>.
 2. Contact Rating: [30-A inductive or resistive, 240-V ac] [20-A ballast load, 120/240-V ac] <Insert rating>.
 3. Program: 8 on-off set points on a 24-hour schedule[and an annual holiday schedule that overrides the weekly operation on holidays].

4. Circuitry: Allow connection of a photoelectric switch relay as substitute for on-off function of a program[on selected channels].
5. Astronomic Time: [All] [Selected] channels.
6. Battery Backup: For schedules and time clock.

F. [Time switches shall Comply with California's Title 24 and be certified by the California Energy Commission.]

2.13 LIGHTING CONTACTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 3. GE Industrial Systems; Total Lighting Control.
 4. Hubbell Lighting.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. Square D; Schneider Electric.
 7. TORK; NSI Industries.
- D. Description: Electrically operated and mechanically held, combination type with non-fused disconnect, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including LED tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation. Refer to FCA value on drawings, at nearest upstream device.
 3. Enclosure: Provide with enclosure complying with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
- E. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
 1. Monitoring: On-off status.
 2. Control: On-off operation.

2.14 AUTOMATIC LOAD CONTROL RELAYS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
 2. Coil Rating: 120 or 277 V, as indicated on Drawings.
 3. Mounting: as indicated on the Drawings]. Mount per manufacturer's instructions.

4. [Auxiliary Relay input: Provisions to shunt emergency lighting on upon receiving a signal from an outside system such as security or fire alarm system.]

2.15 BRANCH CIRCUIT TRANSFER SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings.
- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008.
 1. For control of emergency lighting circuits: Loss of normal power shall cause relay to automatically shunt emergency power to lighting circuit regardless of manual or automatic switch position. Emergency lighting circuit shall continue to operate at full power until normal power has been restored.
 2. Coil Rating: 120 or 277 V as indicated on Drawings.

2.16 CONDUCTORS AND CABLES FOR LIGHTING CONTROL DEVICES

- A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.
- B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- C. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.
- D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.
- E. Provide all necessary conductor and cabling required for operation of the controls and control systems specified. This includes power and control wiring required for the controls to operate as described.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. GENERAL
 1. Install devices and associated power packs and wiring in accordance with manufacturer's instructions and applicable codes.
- B. LINE VOLTAGE WALL SWITCHES
 1. Install dimming wall switches to achieve full rating specified on Lighting Control Device Schedule taking into account de-rating for ganging as instructed by the manufacturer.
 2. Provide a separate grounded (neutral) conductor for each circuit controlled by a line voltage switch.
 - a. Do not share neutral conductor on load side of dimmers.
 - b. If neutral termination is not required for the device, cap conductor and tag as "Neutral for future use".
- C. OCCUPANCY/VACANCY SENSORS AND PHOTOELECTRIC SWITCHES
 1. Arrange a pre-installation meeting with manufacturer's factory authorized field representative, at Owner's facility, to verify placement of sensors and installation criteria.
 2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage areas specified in manufacturer's literature. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms or areas that are to be

provided with sensors. Provide additional sensors as required to properly and completely cover the respective areas.

3. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems and partition assemblies.
4. Occupancy sensors with ultrasonic or dual-technology sensing technologies shall be located not closer than 4 feet from the nearest edge of air supply devices or similar obstructions that would adversely affect the sensor performance.
5. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
6. Install outdoor photoelectric switches with clear view of the northern sky unless noted otherwise on the Drawings.
7. Adjust settings of photoelectric switches to turn on lighting at illumination level indicated on the Drawings.
8. Install devices and auxiliary equipment in compliance with manufacturer's instructions and recommendations.
9. Install relay units where concealed from view and where accessible.
10. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
11. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

D. TIME SWITCHES

1. Program timeclock settings as per Sequence of Operations on the Drawings. Confirm final timeclock settings with Owner prior to programming.

E. LIGHTING CONTACTORS

1. Install lighting contactors in locations as indicated on the Drawings.
2. Provide NEMA 1 enclosures for lighting contactors in interior dry locations, NEMA 3R enclosures for lighting contactors in exterior or wet locations[, and NEMA 4X enclosures for lighting contactors in corrosive environments].
3. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.
4. [Coordinate connection and programming of BAS Interface with controls contractor.]

F. AUTOMATIC LOAD CONTROL RELAYS

1. When used with manual controls, install emergency shunt relay [in separate enclosure adjacent to associated light switch][in accessible ceiling near the control device or wall mounted within electrical room]. Label within enclosure the connected normal and emergency circuits.
2. When used with automatic controls, install where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

G. BRANCH CIRCUIT TRANSFER SWITCHES

1. Install branch circuit transfer switches where concealed from view in accessible ceiling near the automatic control device or wall mounted within electrical room. Label outlet box cover with connected normal and emergency circuits.

H. WIRING

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be [1/2 inch (13 mm)][<insert size>].
2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Power and control wiring: Identify using marker tapes.
 1. Identify controlled circuits in lighting contactors.
 2. Identify circuits or luminaries controlled by photoelectric switches and occupancy sensors at each sensor.
- C. Components: Label each component with self-laminating computer printed labels, using a unique designation matching control drawing.
- D. Cover plates: Refer to drawings for labeling requirements of certain cover plates for manual switches, or similar devices, requiring labeling for user information.
- E. Buttons/switches:
 1. Engraved from manufacturer. Refer to drawings for detailed requirements and text for labeling.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 2. Operational Test: Test all occupancy sensors in test mode to confirm sensor coverage and sensitivity of sensor per manufacturer's instructions. Upon completion of tests, set sensor time delay as indicated on Lighting Control Device Schedule. Follow testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Lighting control devices that fail tests and inspections are defective work. Remove, replace, and retest devices that fail tests.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- B. Photoelectric switch Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project for this purpose.

3.5 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Lighting Control Systems."

- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training" and Division 26 Section "Lighting Control Systems" for additional information

END OF SECTION

SECTION 16455 (261200) - MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

- A. This Section includes the following types of transformers with medium-voltage primaries:
 - 1. Pad-mounted, liquid-filled transformers.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section "General Electrical Requirements" for general requirements and related documents that apply to this section.
- B. Division 26 Section "Common Work Results for Electrical" for raceways, conductors, cables, and cords.
- C. Division 26 Section "Equipment Wiring Systems" for electrical connections to equipment specified under other sections, Divisions, or furnished by the owner.
- D. Division 26 Section "Medium voltage Cables".
- E. Division 26 Section "Low-voltage Electrical Power Conductors and Cables".
- F. Division 26 Section "Grounding and Bonding For Electrical Systems".
- G. Division 26 Section "Raceway and Boxes for Electrical Systems".
- H. Division 26 Section "Underground Ducts and Raceways for Electrical Systems".
- I. Division 26 Section "Vibration and Seismic Controls for Electrical Systems".
- J. Division 26 Section "Identification for Electrical Systems".
- K. Division 26 Section "Overcurrent Protection Device Coordination Study".
- L. Division 26 Section "Medium-voltage switchgear".
- M. Division 26 Section "Low-voltage Switchgear".
- N. Division 26 Section "Electricity Metering".
- O. Division 26 Section "Fuses".

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 and Division 16 Section "General Electrical Requirements".
- B. Product data: Include rated nameplate data, capacities, weights, dimensions, colors, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.
 - 1. Medium-voltage Transformers.
- C. Shop drawings for:

1. Diagram power signal and control wiring.
- D. Coordination Drawings: Floor and site plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Underground primary and secondary conduit stub-up location.
 2. Dimensioned concrete base, outline of transformer, and required clearances.
 3. Ground rod and grounding cable locations.
- E. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Qualification Data: For testing agency.
- G. Source quality-control test reports.
- H. Field quality-control test reports.
- I. Follow-up service reports.
- J. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.
- 1.4 DEFINITIONS
- A. NETA ATS: Acceptance Testing Specification.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- D. Comply with IEEE C2.
- E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.
- F. Comply with NFPA 70.
- G. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store transformers protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.7 PROJECT CONDITIONS

- A. Service Conditions: IEEE C37.121, usual service conditions except for the following:
 1. Exposure to significant solar radiation.
 2. Altitudes above 3300 feet (1000 m).
 3. Exposure to fumes, vapors, or dust.
 4. Exposure to explosive environments.
 5. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
 6. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
 7. Exposure to excessively high or low temperatures.
 8. Unusual transportation or storage conditions.
 9. Unusual grounding-resistance conditions.
 10. Unusual space limitations.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

1.9 QUALIFICATIONS

- A. Provide products listed and classified by Underwriters Laboratories, Inc (UL) as suitable for the purpose specified and indicated.
- B. Materials shall be manufactured by Companies specializing in the products specified in this section with minimum 3 years documented experience.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Electric Corporation; Power Distribution Products Division.
2. Cooper Industries; Cooper Power Systems Division.
3. Eaton Electrical Inc.; Cutler Hammer Products.
4. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
5. GE Electrical Distribution & Control.
6. Hammond Manufacturing; Transformer Group.
7. ABB; Kuhlman Electric Corporation
8. CG Global; Pauwels Transformers,.
9. Pioneer Transformers.
10. Siemens Energy & Automation, Inc.
11. Square D; Schneider Electric.
12. Uptegraff, R. E. Mfg. Co.
13. Virginia Transformer Corp.

2.2 PAD-MOUNTED, THREE-PHASE, LIQUID-FILLED TRANSFORMERS

- A. Description: ANSI C57.12.13, IEEE C57.12.00, pad-mounted, 2-winding transformers. Stainless-steel tank base, cabinet, and sills.
 1. Windings: Aluminum
- B. Insulating Liquid: Mineral oil, complying with ASTM D 3487, Type II, and tested according to ASTM D 117.
- C. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Insulating Liquid: Less flammable, dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- E. Insulating Liquid: Less flammable, silicone-based dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall have low toxicity and be nonhazardous.
- F. Insulation Temperature Rise: 65 deg C when operated at rated kVA output in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.
- G. Basic Impulse Level: 95 kV.
- H. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- I. High-Voltage Switch: 200 A or 600 A, make-and-latch rating of 10-kA RMS, symmetrical, arranged for radial feed with 3-phase, 2-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.
- J. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47.
 1. Current-limiting type in dry-fuse holder wells, mechanically interlocked with liquid-immersed switch in transformer tank to prevent disconnect under load.
 2. Internal liquid-immersed cartridge fuses.
 3. Bay-O-Net liquid-immersed fuses that are externally replaceable without opening transformer tank.

4. Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses. Bay-O-Net fuses shall be externally replaceable without opening transformer tank.
 5. Bay-O-Net liquid-immersed current-limiting fuses that are externally replaceable without opening transformer tank.
- K. Surge Arresters: Distribution class, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1; support from tank wall within high-voltage compartment. Transformers shall have three arresters for radial-feed circuits.
- L. High-Voltage Terminations and Equipment: Live front with externally clamped porcelain bushings and cable connectors suitable for terminating primary cable.
- M. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:
1. Bushing-Well Inserts: One for each high-voltage bushing well.
 2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
 3. Parking Stands: One for each high-voltage bushing well.
 4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.
- N. Accessories:
1. Drain Valve: 1 inch (25 mm), with sampling device.
 2. Dial-type thermometer.
 3. Liquid-level gage.
 4. Pressure-vacuum gage.
 5. Pressure Relief Device: Self-sealing with an indicator.
 6. Mounting provisions for low-voltage current transformers.
 7. Mounting provisions for low-voltage potential transformers.
 8. Busway terminal connection at low-voltage compartment.
 9. Alarm contacts for gages and thermometer listed above.

2.3 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification."

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to federal law 10 CFR Part 431 and ANSI C57.12.50.
- B. Factory Tests: Perform the following factory-certified tests on each transformer:
1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
 2. Ratios on rated-voltage connection and on tap extreme connections.
 3. Polarity and phase relation on rated-voltage connection.
 4. No-load loss at rated voltage on rated-voltage connection.
 5. Excitation current at rated voltage on rated-voltage connection.
 6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
 7. Applied potential.
 8. Induced potential.

9. Temperature Test: If transformer is supplied with auxiliary cooling equipment to provide more than one rating, test at lowest kilovolt-ampere Class OA or Class AA rating and highest kilovolt-ampere Class OA/FA or Class AA/FA rating.
 - a. Temperature test is not required if record of temperature test on an essentially duplicate unit is available.
10. Owner will witness all required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.
- B. Examine roughing-in of conduits and grounding systems to verify the following:
 1. Wiring entries comply with layout requirements.
 2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and that requirements in Division 16 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on concrete bases.
 1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Electrical Supports and Seismic Restraints."
 - a. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and 4 inches (100 mm) high.
 - b. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
 - c. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - d. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
 - e. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - f. Tack-weld or bolt transformers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.
 2. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions, NFPA 70, and the local utility companies.
- B. IDENTIFICATION
 1. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."
- C. CONNECTIONS

1. Ground equipment according to Division 16 Section "Grounding and Bonding."
2. Connect wiring according to Division 16 Section "Conductors and Cables."

D. FIELD QUALITY CONTROL

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
2. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
3. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
4. Perform the following field tests and inspections and prepare test reports:
 - a. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
 - b. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
 - c. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Remove and replace malfunctioning units and retest as specified above.
6. Test Reports: Prepare written reports to record the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

E. FOLLOW-UP SERVICE

1. Voltage Monitoring and Adjusting: If requested by Owner, perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:
 - a. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch (25 mm) per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
 - b. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:
 - c. Adjust transformer taps.
 - d. Prepare written request for voltage adjustment by electric utility.
 - e. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
 - f. Report: Prepare written report covering monitoring and corrective actions performed.
2. Infrared Scanning: Perform as specified in Division 16 Section "Medium-Voltage Switchgear."

3.3 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

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SECTION 16460 (261323) - MEDIUM-VOLTAGE METAL-ENCLOSED SWITCHGEAR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Switchgear enclosure.
2. Fusible load interrupter switchgear.
3. Load interrupter switchgear with circuit breakers.
4. Circuit breaker switchgear.
5. Power transfer configurations.
6. Instruments.
7. Protective relays.
8. AC control power supply.
9. DC control power supply.
10. Warning labels and signs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For medium-voltage, metal-enclosed switchgear.

1. Include a tabulation of installed devices with features and ratings.
2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Elevations must show major components, features, and mimic bus diagram.
3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended work space, and locations of penetrations for grounding and conduits. Show location of anchor bolts.
4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Locate accessory and spare equipment storage.
6. Include single-line diagram.
7. Include control power wiring diagrams.
8. Include batteries, battery rack, and equipment base.
9. Include copy of nameplate.
10. Ratings of the assembled switchgear:
 - a. Voltage.
 - b. Continuous current.
 - c. Short-circuit rating.
 - d. Basic Insulation Level.
11. Utility company's metering provisions with indication of approval by utility company.
12. Wiring Diagrams: For each switchgear assembly include the following:
 - a. Power, signal, and control wiring.
 - b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
 - c. Schematic control diagrams.

- d. Diagrams showing connections of component devices and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Manufactured Unit: Metal-enclosed switchgear, designed for application in solidly grounded neutral system.
- B. Switchgear Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory, and marked for intended location and application.
- C. Comply with IEEE C37.20.3.

2.2 MANUFACTURERS

- A. ABB
- B. Eaton
- C. Siemens
- D. Square D by Schneider Electric

2.3 SWITCHGEAR ENCLOSURE

- A. Outdoor Enclosure: Weatherproof, galvanized steel, designed for installation outdoors. Aisleless, full-height doors, with provisions for padlocking, in front of basic weatherproof equipment. Integral structural-steel base frame with factory-applied asphaltic undercoating.
- B. The enclosure must meet IEEE C37.20.3 Annex A, Category A enclosure requirements.
 - 1. Each vertical section must have the following features:
 - a. Structural design and anchorage adequate to resist loads imposed by 125 mph (200 km/h) wind.
 - b. Space heater operating at one-half or less of rated voltage, sized to prevent condensation, controlled by thermostats to maintain temperature of each section above expected dew point.
 - c. Louvers equipped with insect and rodent screens and filters, and arranged to permit air circulation while excluding rodents and exterior dust.
 - d. Weatherproof ground-fault circuit interrupter duplex receptacle.
 - e. Power for heaters and receptacles must be provided by control power transformer.
 - f. Skid Mounted: Mount each shipping group on an integral base frame as a complete weather-proof unit.
- C. Enclosure Finish:

1. Outdoor Finish: Factory-applied finish in manufacturer's standard color, including under surfaces treated with corrosion-resistant undercoating.

2.4 FUSIBLE LOAD INTERRUPTER SWITCHGEAR

A. Construction:

1. Deadfront, metal-enclosed, fixed-mount, ~~arc-resistant~~, fusible interrupter switchgear assembly of vertical sections.
 - a. Front and rear access switchgear.
 - b. Viewing window to show view of the position of the three poles of the interrupter.
 - c. Mechanical interlock preventing the door from opening when the switch is open and requiring the door to be closed before the switch can be closed.
 - d. Padlocking and tagging the switch in the opened or closed position.
 - e. Switch position indicator.
 - f. Front and rear vertical section covers must have ~~standard full length~~ hinges. The front cover must be a flanged door with latching hardware. The rear cover may be bolted.
2. Bus: Silver-plated copper.
 - a. Ground Bus: Sized to carry the rated short-time withstand current and connected to the metal enclosures of each vertical section.
3. Auxiliary Vertical Sections and Compartments:
 - a. Utility metering compartment that complies with utility company requirements.
 - b. Owner's Metering: Vertical section with a front hinged door for isolated access to meters and associated terminal and fuse blocks for maintenance, calibration or testing while the gear is energized.

- ### B. Surge Arresters: Comply with IEEE C62.11, distribution class; metal-oxide-varistor type, connected in each phase of incoming circuit and ahead of disconnecting device.

C. Switches: Load interrupter type, with fuses. Omit fuses where specifically indicated.

1. Switch Operator: Manual.
2. Switch Construction:
 - a. Grounded, metal shield to cover live components and terminals.
 - b. Supported entirely by interior framework of structure, with copper switchblades and stored-energy operating mechanism.
 - c. Phase barriers, full length of switchblades and fuses for each pole; readily removable and replaceable; designed to allow visual inspection of switch components when barrier is in place.
3. Fuses:
 - a. Installed on a single mounting frame, de-energized when the switch is open.
 - b. Current-Limiting Fuses: Full-range, fast-replaceable, current-limiting type that will operate without explosive noise or expulsion of gas, vapor, or foreign matter from tube.
 - c. Indicator integral with each fuse to show when it has blown.
 - d. Spares: Include three fuses in use and three spare fuses in storage clips in each switch.

D. Accessory Set:

1. Tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation.
2. Fuse-handling tool recommended by switchgear manufacturer.

E. Capacities and Characteristics:

1. Switchgear Assembly:
 - a. Rated Maximum Voltage and BIL: 15 kV, 95 kV.
 - b. Rated Continuous Current: 1200 A.
 - c. Rated Momentary Withstand Current (600 A and 1200 A Continuous Current Ratings): 40 kA ASYM RMS for 10 cycles.

- d. Rated Short-Time Withstand Current (600 A and 1200 A Continuous Current Ratings): 25 kA SYM RMS for 2 s.
2. Non-Fused Load Interrupter Switch:
 - a. Rated Continuous Current and Load Switching Current: 1200 A.
 - b. Rated Momentary Withstand Current: 40 kA ASYM RMS for 10 cycles.

2.5 FUSED SWITCHES WITH CURRENT LIMITING FUSES:

- A. Fuse Type and Rated Continuous Current: [Insert fuse type], [Insert amperage].
- B. Fuse Interrupting Rating: <Insert value> kA SYM RMS.
- C. Fault Close Current Rating: <Insert value> kA ASYM.

2.6 INSTRUMENTS

- A. Instrument Transformers: Comply with IEEE C57.13.
 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C 12.11 accuracy class of 0.3 with burdens of W, X, and Y.
 2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.
- B. Multifunction Digital Meter and Monitor: Microprocessor-based unit suitable for three- or four-wire systems.
 1. Inputs from sensors or 5 A current-transformer secondaries, and potential terminals rated to 600 V.
 2. Switch-selectable digital display with the following features:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power: Plus or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
 - i. Accumulated energy, in megawatt hours (megajoules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
 3. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements in accordance with Section 260913 "Electrical Power Monitoring and Control."
 4. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door.

2.7 WARNING LABELS AND SIGNS

- A. Comply with requirements for labels and signs specified in Section "Identification for Electrical Systems."
 1. Warning signs must be baked enamel signs.
 2. Equipment Identification Labels: Laminated acrylic or melamine label.

2.8 SOURCE QUALITY CONTROL

- A. Perform production tests on each circuit breaker housing for this Project, complying with IEEE C37.20.3:

1. Perform mechanical operation tests to ensure proper functioning of shutters, operating mechanism, mechanical interlocks, and interchangeability of removable elements that are designed to be interchangeable.
 2. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
 3. Perform the control wiring dielectric test at 1500 V for one minute.
- B. Perform production tests, on each circuit breaker supplied for this Project, complying with IEEE C37.20.4.
1. Perform mechanical operation tests to ensure proper functioning of the switch.
 2. Verify the contact gap. Perform terminal-to-terminal resistance test.
 3. Verify that control wiring is correct by verifying continuity. Perform electrical operation of relays and devices to ensure they function properly and in the intended sequence.
 4. Perform the control wiring dielectric test at 1500 V for one minute.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHGEAR

- A. Upon delivery of switchgear and prior to unloading, inspect equipment for damage. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Equipment Mounting:
1. Install switchgear on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Switchgear must be installed level and plumb. Switchgear must tilt less than 1.5 degrees while energized.
- D. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's written instructions and NFPA 70.
- E. Comply with NECA 430.

3.2 CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Grounding Connections at Exterior Locations:
1. Bond surge arrester and neutrals directly to the switchgear enclosure and then to the grounding electrode system with bare copper conductors, sized as shown.
 2. Keep lead lengths as short as practicable with no kinks or sharp bends.
 3. Fence and equipment connections must not be smaller than No. 4 AWG.
 4. Ground fence at each gate post and corner post and at intervals not exceeding 10 ft. (3 m).
 5. Bond each gate section to the fence post using 1/8 by 1 inch (3 by 25 mm) tinned flexible braided copper strap and clamps.
 6. Make joints in grounding conductors and loops by exothermic weld or compression connector.

- C. Terminate all grounding and bonding conductors on a common equipment grounding terminal on the switchgear enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate the number of conductors for termination.
- D. Complete switchgear grounding and lightning arrester connections prior to making any other electrical connections.
- E. Terminate medium-voltage cables in accordance with Section 260513 "Medium-Voltage Cables."

3.3 SIGNS AND LABELS

- A. Comply with the installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
- B. Install warning signs as required to comply with OSHA in 29 CFR 1910.269.

3.4 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and/or electric utility, if required.
- B. General Field Testing Requirements:
 - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods."
 - 2. After installing switchgear and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
- C. Medium-Voltage Switchgear Assembly Field Tests:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that fuse and circuit breaker sizes and types correspond to Drawings and coordination study.
 - b. Verify that current and voltage transformer ratios correspond to Drawings.
 - c. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - d. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - e. Attempt closure on locked-open devices. Attempt to open locked-closed devices.
 - f. Make key exchange with devices operated in off-normal positions.
 - g. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - h. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - i. Verify correct barrier and shutter installation and operation.
 - j. Exercise active components.
 - k. Inspect mechanical indicating devices for correct operation.
 - l. Verify that filters are in place and vents are clear.
 - m. Perform visual and mechanical inspection of instrument transformers in accordance with Article "Instrument Transformer Field Tests."
 - n. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

- 2) Verify that primary and secondary fuse or circuit breaker ratings match drawings.
 - 3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.
2. Electrical Tests:
- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Perform dc voltage insulation-resistance tests on each bus section, phase to phase and phase to ground, for one minute. If the temperature of the bus is other than plus or minus 20 deg C, adjust the resulting resistance as provided in NETA ATS, Table 100.11.
 - 1) Insulation-resistance values of bus insulation must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.
 - 2) Do not proceed to the dielectric withstand voltage tests until insulation-resistance levels are raised above minimum values.
 - c. Perform a dielectric withstand voltage test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it must be conducted in accordance with NETA ATS, Table 100.2. Apply the test voltage for one minute.
 - 1) If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - 1) Minimum insulation-resistance values of control wiring must not be less than two megohms.
 - e. Control Power Transformers:
 - 1) Perform insulation-resistance tests. Perform measurements from winding to winding and each winding to ground. Insulation-resistance values of winding insulation must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.1.
 - 2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.
 - 3) Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
 - 4) Verify correct function of control transfer relays located in the switchgear with multiple control power sources.
 - f. Voltage Transformers:
 - 1) Perform secondary wiring integrity test. Verify correct potential at all devices.
 - 2) Verify secondary voltages by energizing the primary winding with system voltage.
 - g. Perform current-injection tests on the entire current circuit in each section of switchgear.
 - 1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

- h. Perform system function tests in accordance with "System Function Tests" Article.
- i. Verify operation of space heaters.

D. Instrument Transformer Field Tests:

1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data complies with Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Verify correct connection of transformers with system requirements.
 - d. Verify that adequate clearances exist between primary and secondary circuit wiring.
 - e. Verify the unit is clean.
 - f. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.
 - h. Verify that required grounding and shorting connections provide contact.
 - i. Verify correct operation of transformer withdrawal mechanism and grounding operation.
 - j. Verify correct primary and secondary fuse sizes for voltage transformers.
 - k. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical Tests of Current Transformers:
 - a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 1000 V(dc) for one minute. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's written recommendations. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
 - c. Perform a polarity test of each current transformer in accordance with IEEE C57.13.1. Polarity results must agree with transformer markings.
 - d. Perform a ratio-verification test using the voltage or current method in accordance with IEEE C57.13.1. Ratio errors must be in accordance with IEEE C57.13.
 - e. Perform an excitation test on transformers used for relaying applications in accordance with IEEE C57.13.1. Excitation results must match the curve supplied by the manufacturer or be in accordance with IEEE C57.13.1.
 - f. Measure current circuit burdens at transformer terminals in accordance with IEEE C57.13.1. Measured burdens must be compared with and must match instrument transformer ratings.
 - g. Perform insulation-resistance tests on the primary winding with the secondary grounded. Test voltages must be in accordance with Table 100.5.
 - h. Perform dielectric withstand tests on the primary winding with the secondary grounded. Test voltages must be in accordance with Table 100.9.
 - i. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.
 - j. Verify that current transformer secondary circuits are grounded and have only one grounding point in accordance with IEEE C57.13.3. That grounding point should be located as specified by the engineer in the project drawings.
3. Electrical Tests of Voltage Transformers:
 - a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- b. Perform insulation-resistance tests winding-to-winding and each winding to ground. Test voltages must be applied for one minute in accordance with Table 100.5. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's recommendations. Investigate and correct values of insulation resistance less than manufacturer's recommendations or NETA ATS, Table 100.5.
- c. Perform a polarity test on each transformer to verify the polarity marks or H1- X1 relationship as applicable. Polarity results must agree with transformer markings.
- d. Perform a turns-ratio test on all tap positions. Ratio errors must be in accordance with IEEE C57.13.
- e. Measure voltage circuit burdens at transformer terminals. Measured burdens must be compared with and must match instrument transformer ratings.
- f. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data. Power-factor or dissipation-factor values must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.
- g. Verify that voltage transformer secondary circuits are grounded and have only one grounding point in accordance with IEEE C57.13.3. Test results must indicate that the circuits are grounded at only one point.

E. Ground Resistance Test:

- 1. Visual and Mechanical Inspection:
 - a. Verify ground system complies with the Contract Documents and NFPA 70 Article 250, "Grounding and Bonding."
 - b. Inspect physical and mechanical condition. Grounding system electrical and mechanical connections must be free of corrosion.
 - c. Inspect bolted electrical connections using a calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - d. Inspect anchorage.
- 2. Electrical Tests:
 - a. Perform fall-of-potential or alternative test in accordance with IEEE 81 on the main grounding electrode or system. The resistance between the main grounding electrode and ground must be no more than 5 ohms.
 - b. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points. Investigate point-to-point resistance values that exceed 0.5 ohms. Compare equipment nameplate data with Contract Documents.
 - c. Inspect physical and mechanical condition.
 - d. Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

F. Metering Devices Field Tests:

- 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect bolted electrical connections using calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.
 - c. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts, as applicable.

- d. Verify the unit is clean.
 - e. Verify freedom of movement, end play, and alignment of rotating disk(s).
2. Electrical Tests:
- a. Inspect bolted electrical connections using a low resistance ohmmeter to compare bolted resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Verify accuracy of meters at all cardinal points. Meter accuracy must be in accordance with manufacturer's published data.
 - c. Calibrate meters in accordance with manufacturer's published data. Calibration results must be within manufacturer's published tolerances.
 - d. Verify all instrument multipliers. Instrument multipliers must be in accordance with system design specifications.
 - e. Verify that current transformer and voltage transformer secondary circuits are intact. Test results must confirm the integrity of the secondary circuits of current and voltage transformers.

G. Medium-Voltage Surge Arrester Field Tests:

1. Visual and Mechanical Inspection:
- a. Verify that equipment nameplate data complies with Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify the arresters are clean.
 - e. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - f. Verify that the stroke counter is correctly mounted and electrically connected if applicable. Record the stroke counter reading.
2. Electrical Test:
- a. Perform an insulation-resistance test on each arrester, phase terminal to ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to meet recommended minimum insulation resistance listed in the table.
 - b. Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.
 - c. Test grounding connections. Resistance between the arrester ground terminal and the ground system must be less than 0.5 ohm.

H. Microprocessor-Based Protective Relay Field Tests:

1. Visual and Mechanical Inspection:
- a. Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.
 - b. Verify operation of light-emitting diodes, display, and targets.
 - c. Record passwords for each access level.
 - d. Clean the front panel and remove foreign material from the case.
 - e. Check tightness of connections.
 - f. Verify that the frame is grounded in accordance with manufacturer's instructions.
 - g. Set the relay in accordance with results in Section 260573.16 "Coordination Studies" and in Section 260573.19 "Arc-Flash Hazard Analysis."
 - h. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.
2. Electrical Tests:
- a. Perform insulation-resistance tests from each circuit to the grounded frame in accordance with manufacturer's published data.
 - b. Apply voltage or current to analog inputs, and verify correct registration of the relay meter functions.
 - c. Functional Operation: Check functional operation of each element used in the protection

scheme as follows:

- 1) Timing Relay:
 - a) Determine time delay.
 - b) Verify operation of instantaneous contacts.
- 2) Volts/Hertz Relay:
 - a) Determine pickup frequency at rated voltage.
 - b) Determine pickup frequency at a second voltage level.
 - c) Determine time delay.
- 3) Sync Check Relay:
 - a) Determine closing zone at rated voltage.
 - b) Determine maximum voltage differential that permits closing at zero degrees.
 - c) Determine live line, live bus, dead line, and dead bus set points.
 - d) Determine time delay.
 - e) Verify dead bus/live line, dead line/live bus, and dead bus/dead line control functions.
- 4) Undervoltage Relay:
 - a) Determine dropout voltage.
 - b) Determine time delay.
 - c) Determine time delay at a second point on the timing curve for inverse time relays.
- 5) Directional Power Relay:
 - a) Determine minimum pickup at maximum torque angle.
 - b) Determine closing zone.
 - c) Determine maximum torque angle.
 - d) Determine time delay.
 - e) Verify time delay at a second point on the timing curve for inverse time relays.
 - f) Plot the operating characteristic.
- 6) Current Balance Relay:
 - a) Determine pickup of each unit.
 - b) Determine percent slope.
 - c) Determine time delay.
- 7) Negative Sequence Current Relay:
 - a) Determine negative sequence alarm level.
 - b) Determine negative sequence minimum trip level.
 - c) Determine maximum time delay.
 - d) Verify two points on the I-two-squared-t curve.
- 8) Phase Sequence or Phase Balance Voltage Relay:
 - a) Determine positive sequence voltage to close the NO contact.
 - b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
 - c) Verify negative sequence trip.
 - d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
 - e) Determine time delay to close the NC contact upon removal of voltage when previously set to rated system voltage.
- 9) Instantaneous Overcurrent Relay:

- a) Determine pickup.
 - b) Determine dropout.
 - c) Determine time delay.
- 10) Time Overcurrent:
- a) Determine minimum pickup.
 - b) Determine time delay at two points on the time current curve.
- 11) Ground Detector Relay:
- a) Determine maximum impedance to ground causing relay pickup.
- 12) Directional Overcurrent Relay:
- a) Determine directional unit minimum pickup at maximum torque angle.
 - b) Determine closing zone.
 - c) Determine maximum torque angle.
 - d) Plot operating characteristics.
 - e) Determine overcurrent unit pickup.
 - f) Determine overcurrent unit time delay at two points on the time current curve.

d. Control Verification:

- 1) Functional Tests:
- a) Check operation of all active digital inputs.
 - b) Check output contacts or silicone-controlled rectifiers (SCRs), preferably by operating the controlled device, such as circuit breaker, auxiliary relay, or alarm.
 - c) Check internal logic functions used in protection scheme.
 - d) Upon completion of testing, reset min/max recorders, communications statistics, fault counters, sequence-of-events recorder, and event records.
- 2) In-Service Monitoring: After the equipment is initially energized, measure magnitude and phase angle of inputs and verify expected values.

I. Nonconforming Work:

- 1. Switchgear will be considered defective if it does not pass tests and inspections.
- 2. Remove and replace defective units and retest.

J. Prepare test and inspection reports. Record as-left set points of adjustable devices.

3.5 SYSTEM FUNCTION TESTS

- A. System function tests must prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
- 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.

END OF SECTION

SECTION 16321 (262413) - SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service and distribution switchboards 600 V and less.
- B. Surge Protection Devices.
- C. Disconnecting and overcurrent protective devices.
- D. Instrumentation.
- E. Accessory components and features.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.3 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Detail utility company's metering provisions with indication of approval by utility company.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Overcurrent Protective Device Coordination Study"
- D. Field Quality-Control Reports:

1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Handle and prepare switchboards for installation according to NECA 400.
- C. Environmental Limitations:
1. Do not deliver or install switchboards until spaces are enclosed and weather tight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- D. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- E. Remove loose packing and flammable materials from inside switchboards.
- F. Connect temporary electric heating (250 W per section) to prevent condensation.

1.6 FIELD CONDITIONS

- A. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

- A. Warranty Period: Five years from date of Substantial Completion.

1.8 SEISMIC REQUIREMENTS

- A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 "Seismic Controls for Electrical Systems" and Division 20 Section "Seismic Controls for MEP/F/T Systems".

PART 2 - PRODUCTS

2.1 SERVICE AND DISTRIBUTION SWITCHBOARDS, 600 VOLTS AND LESS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable products by one of the following, the first listed manufacturer was used as the basis of design:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- D. Nominal System Voltage: As indicated.
- E. Main-Bus Continuous: As indicated.
- F. Indoor Enclosures: Steel, NEMA 250, Type 1.
- G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- H. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers

having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

- I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- J. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- K. Buses: Three phase, four wire unless otherwise indicated.
 - 1. Phase, and Neutral Buses:
 - a. Material:
 - 1) Tin-plated aluminum.
 - a) Hard-drawn copper, 98 percent conductivity, may be substituted if provided at no additional cost.
 - 2) Hard-drawn copper, 98 percent conductivity.
 - b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus
 - 2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - a. Material: Hard-drawn copper, 98 percent conductivity
 - b. Size: Minimum-size required by UL 891
- L. Line-Side Conductor Connectors (Lugs):
 - 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Material: Same as bus material.
 - 3. Capacity rating: Same as associated bus.
 - 4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.
- M. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- N. Service Equipment Label: Where used as service entrance equipment, provide NRTL label for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.
- O. Main switchboards used as service entrance equipment shall be provided with infrared windows in quantities and locations to provide line-of-sight viewing of all cable terminations on the line side of the main overcurrent protective device.

2.2 SURGE PROTECTION DEVICES

- A. Provide surge protective devices as required by Division 26 Section "Surge Protective Devices".

- B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Arc Flash Mitigation

- 1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

- 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
- 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical or compression style as indicated, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Under voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- 7. Service-Rated Switches: Labeled for use as service equipment.
- 8. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.

- a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - D. Fuses are specified in Division 26 Section "Fuses."

2.4 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 - 1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - 2. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.

2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install switchboards and accessories according to NECA 400.
- C. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard with a nameplate.
- C. Device Nameplates: Label each branch circuit device in distribution switchboard with a nameplate.
- D. Warning Labels:
 - 1. Label each switchboard with a warning label in accordance with NFPA70 and NFPA 70E.
- E. Identify field-installed conductors, interconnecting wiring, and components.
- F. Instruction Sign: Provide clear, detailed, written instructions, permanently attached to the electrical gear being served by it for staff reference.
- G. One-Line: Provide a laminated, color-coded, large-format one-line diagram showing the new work is to be provided and installed in the associated electrical room.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NECA 400. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove necessary panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories].

END OF SECTION

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SECTION 16442 (262416) - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Distribution panelboards.
- B. Lighting and appliance branch-circuit panelboards.
- C. Disconnecting and Overcurrent Protective Devices.
- D. Fused Lighting and Appliance Branch-Circuit Panelboards.
- E. Surge Protection Devices.
- F. Accessory Components and Features.

1.2 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit electronic files, in an SKM-compatible format.

- C. Fault-Current Study, Coordination Study, and Overcurrent Protective Device Settings report must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If studies have not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project. Refer to specification section "Overcurrent Protective Device Coordination Study"
- D. Qualification Data: For qualified testing agency.
- E. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: Submit final panelboard directories.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for panelboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to occupied facilities. Refer to Division 26 Section "General Electrical Requirements" for allowable outages.

1.8 WARRANTY

- | |
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| <p>A. <u>Warranty in accordance with requirements of DIV 01 and section 16050 (26 05 00).</u> Warranty Period: Five years from date of Substantial Completion.</p> |
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1.9 SEISMIC REQUIREMENTS

- A. Seismic bracing, restraints, and controls for all electrical systems specified herein shall be designed and installed as required by Division 26 Section "Seismic Controls for Electrical Systems" and Division 20 Section "Seismic Controls for MEP/F/T Systems".

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Enclosures: Flush- or surface-mounted cabinets as noted.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen and/or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
 2. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 3. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and/or bottom as required.
- D. Buses: Three phase, four wire unless otherwise indicated.
 1. Phase, and Neutral Buses:
 - a. Material:
 - 1) Tin-plated aluminum.

- a) Hard-drawn copper, 98 percent conductivity, may be substituted if provided at no additional cost.
 - 2) Hard-drawn copper, 98 percent conductivity.
 - b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of panelboard's sections.
 - 1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus
 - 2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - a. Material: Hard-drawn copper, 98 percent conductivity
 - b. Size: Minimum-size required by UL 67
 - 3. Split Bus: Vertical buses divided horizontally into individual vertical sections.
- E. Line-Side Conductor Connectors (Lugs):
- 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Material: Same as bus material.
 - 3. Capacity rating: Same as associated bus.
 - 4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.
- F. Feed-Through Lugs:
- 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Location: Locate at opposite end of bus from line side lugs or main device.
 - 3. Material: Same as line side conductor connectors.
 - 4. Capacity rating: Same as associated bus.
 - 5. Type: Same as line side conductor connectors.
- G. Subfeed lugs (Double Lugs):
- 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Location: Locate at same end of bus as incoming lugs or main device.
 - 3. Material: Same as line side conductor connectors.
 - 4. Capacity rating: Same as associated bus.
 - 5. Type: Same as line side conductor connectors.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating – Fully Rated: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. See manufacturers above.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: As indicated on drawings.

- E. Branch Overcurrent Protective Devices:
 - 1. Connection to bus:
 - a. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - b. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 2. Type: Provide types as indicated on drawings and as defined below.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. See manufacturers above.
- B. Panelboards: Circuit breaker type: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on drawings.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. See manufacturers above.
- B. Arc Flash Mitigation
 - 1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical type unless otherwise indicated on Drawings, suitable for number, size, trip ratings, and conductor materials.

- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 1) Mounting: Integral
 - e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [on] [off] [on or off] position.
 - f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- A. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - D. Fuses are specified in Division 26 Section "Fuses."

2.5 FUSED LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS (30 TO 400A MAINS)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman Quik Spec Coordination Panelboards type QSCP
- B. Bus Bars: Shall be tin-plated copper.
- C. Panelboards: listed to UL 67
 - 1. Provide space behind locking door for a minimum of 6 spaces to store replacement branch circuit fuses.
- D. Mains:
 - 1. Permanently installed lockout means shall be provided.
 - 2. Quick-make, quick-break type.
- E. Branch Overcurrent Protective Devices:
 - 1. Device shall have visible circuit ON/OFF indication with colored and international symbol markings
 - 2. Device shall provide open fuse indication via permanently installed neon or LED indicating light.
 - 3. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
 - 4. No special tools shall be required for fuse removal.
 - 5. Devices shall have bolt-on style bus connectors.
 - 6. Device housing shall be clearly marked with device amperage.
 - 7. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be provided.
 - 8. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.
 - 9. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class J* performance characteristics. Cooper Bussmann UL class CF CUBEFuse meets this requirement.

2.6 SURGE PROTECTION DEVICES

- A. Provide surge protective devices as required by Division 26 Section "Surge Protective Devices".
- B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Wall-Mounted Panelboards: Install panelboards on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For panelboards not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 72 inches (1788 mm) above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with a nameplate.

- C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate.
- D. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.
 - 1. Exception: Do not install NFPA 70 working clearance requirements on flush panelboards and similar equipment in finished spaces.
- E. Identify field-installed conductors, interconnecting wiring, and components; complying with Division 26 Section "Identification for Electrical Systems."
- F. Panel Directories
 - 1. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
 - 2. Note the date the directory was created/updated.
 - 3. Create directory after loads have been balanced.

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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SECTION 16140 (262726) - WIRING DEVICES

PART 1 - GENERAL

- A. This Section includes the following:
 - 1. Receptacles: Single, duplex, twist-lock, ground-fault circuit interrupters (GFCI), isolated ground (IG)
 - 2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary, pilot light and lighted toggle.
 - 3. Device Wall Plates.
 - 4. Emergency Power Off Buttons

1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. IG: Isolated Ground
- C. PIR: Passive Infrared.
- D. RFI: Radio Frequency Interference
- E. SPD: Surge Protective Device
- F. USB: Universal Serial Bus
- G. TR: Tamper Resistant

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.
- B. Product data for the following products:
 - 1. Provide manufacturer’s catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, cover plates, power poles, and multi-outlet assemblies.
- C. Shop drawings for:
 - 1. List of legends and description of materials and process used for pre-marking wall plates.
- D. Field quality-control test reports.
- E. Operations and Maintenance Data:
- F. Warranty: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.

- B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.
- C. Electrical Components, Devices, and Accessories:
 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
 2. Marked for intended use.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

1.6 SPARES

- A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Receptacles and Switches:
 - a. Cooper Wiring Devices.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Mfg. Company Inc.
 - d. Pass & Seymour/Legrand; Wiring Devices Div.
 2. Emergency Power Off Buttons:
 - a. GE Industrial.
 - b. Square D/Groupe Schneider NA.
 - c. Eaton.
- B. In other Part 2 articles below, where lists of manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:
 1. Additional Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph "Manufacturers" above.

2.3 FINISHES

A. Color:

1. Wiring devices connected to normal power systems: As selected by Architect unless otherwise indicated or required by NFPA 70. Cover plates: The same as the wiring device.
2. Wiring devices connected to emergency power systems: Red Cover plates: The same as the wiring device and engraved with "EMERGENCY POWER" with white filler in the engraving. Engrave the panelboard designation and circuit number serving the emergency device into the cover plate.
3. Isolated-Ground receptacles: Orange with an orange triangle on its face. Cover plates: [The same as the wiring device and engraved with "ISOLATED GROUND" at the top with white filler in the engraving.

B. Manufacturer's model numbers listed are to establish the quality of the wiring devices. Coordinate the proper suffixes in order to provide the correct color as specified above.

2.4 CONVENIENCE RECEPTACLES:

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.

B. Duplex convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

<u>Manufacturer</u>	<u>Duplex</u>	<u>Single</u>
Cooper	5362	5351
Hubbell	5352A	HBL5361
Leviton	5352	5261
Pass & Seymour	5362	5361

C. Duplex weather resistant convenience receptacles: Heavy Duty Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

<u>Manufacturer</u>	<u>Duplex</u>
Cooper	TWR270
Hubbell	5362WR
Leviton	WBR20
Pass & Seymour	WR5862

D. Twist-Locking type receptacles: NEMA L5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, self-grounding.

<u>Manufacturer</u>	<u>Single</u>
Cooper	L520R
Hubbell	HBL2310
Leviton	2310
Pass & Seymour	L520-R

- E. Automatically Controlled receptacles: Where indicated on drawings, provide device type from other applicable category, along with marking for controlled receptacles as required by the current version of the NEC. In the case where the NEC is not applicable to the project, the device shall still be provided with this marking. In that case, the NEC is providing the standard for the marking and this specification is requiring it to be marked above and beyond the application of the code.

2.5 GFCI RECEPTACLES

- A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

<u>Manufacturer</u>	<u>Specification Grade</u>
Cooper	VGf2
Hubbell	GF20LA
Leviton	T7899-H
Pass & Seymour	2095

- B. Ground fault circuit interrupter type weather-resistant receptacles: Specification Grade listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

<u>Manufacturer</u>	<u>Specification Grade</u>
Cooper	WRVGf20
Hubbell	GFTR20
Leviton	W7899
Pass & Seymour	2095TRWR

- C. Ground fault circuit interrupter with Blank Face: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

<u>Manufacturer</u>	<u>Specification Grade</u>
Cooper	VGfD20
Hubbell	GFBF20
Leviton	7595

- D. Ground fault circuit interrupter with Isolated Ground: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

<u>Manufacturer</u>	<u>Specification Grade</u>
Cooper	N/A
Hubbell	N/A
Leviton	2095IGTRW
Pass & Seymour	N/A

2.6 ISOLATED GROUND RECEPTACLES

- A. Isolated ground receptacles: Heavy Duty Specification grade NEMA 5-20R NEMA L5-20R, 125V, 20A, grounding type, UL listed and labeled, nylon face, side and back wired, furnished with a green pigtail connected to the grounding contact, and grounding contacts electrically isolated from the mounting strap.

<u>Manufacturer</u>	<u>[Straight Blade]</u>	<u>[Locking]</u>
Cooper	IG5362	IGL520R
Hubbell	IG5352	IG2310
Leviton	5362-IG	2310-IG
Pass & Seymour	IG5362	N/A

2.7 SWITCHES

- A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide switches equivalent to those specified for 20A, but rated for 15A.
- B. Switches: Heavy Duty Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.

<u>Manufacturer</u>	<u>1 Pole</u>	<u>2 Pole</u>	<u>3 Way</u>	<u>4 Way</u>
Cooper	AH1221	AH2221	AH3221	AH4221
Hubbell	1221	1222	1223	1224
Leviton	1221-2	1222-2	1223-2	1224-2

Pass & Seymour CSB20AC1 CSB20AC2 CSB20AC3 CSB20AC4

- C. Key operated light switches: Same as standard light switches except toggle handle shall be operated by a factory provided key.

<u>Manufacturer</u>	<u>1 Pole</u>	<u>2 Pole</u>	<u>3 Way</u>	<u>4 Way</u>
Cooper	221L	2222L	2223L	2224L
Hubbell	HBL1221L	HBL1222L	HBL1223L	HBL1224L
Leviton	1221-2KL	122202KL	1223-2KL	1224-2KL
Pass & Seymour	PS20AC1-L	PS20AC2-L	PS20AC3-L	PS20AC4-L

- D. Switches for use with mechanically-held, electrically-operated lighting contactors: Single pole, double throw, momentary, center off switch, rated for 120/277V, and UL listed and labeled.

<u>Manufacturer</u>	<u>1 Pole</u>
Cooper	1995
Hubbell	HBL1557
Leviton	1257-I
Pass & Seymour	1251

2.8 DUAL VOLTAGE SWITCH RELAY

- A. A normally-open, electrically-held relay that allows a single-pole switch to control loads operating at two different voltages (e.g., 120V and 277V); listed to UL Standard 916; installed in a 2-gang outlet box, with a voltage-separating barrier and plaster ring.

<u>Manufacturer</u>	<u>Model Number</u>
Lighting Controls and Design	GR 2001 DV – X

2.9 COVER PLATES

- A. Damp Location Weatherproof Receptacle Cover Plates: UL-listed Wet Location (cover closed, not in use); die-cast, gasketed (factory-installed) self-closing covers, for horizontal or vertical mounting as indicated:

<u>Manufacturer</u>	<u>Horizontal</u>	<u>Vertical</u>
Cooper	1966	966
Hubbell	RW51020	RW51040
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Leviton	4990	4978
Pass & Seymour	4511	4512

- A. Wet Location Weatherproof Receptacle Cover Plates (Outlet Box Hood): NEMA 3R weather resistant recessed or flush mount, die cast aluminum lockable cover. Configure cover for horizontal mounting of receptacle or as indicated otherwise. Back box must be suitable for conduit connections. Coordinate back box with wall depth.

<u>Manufacturer</u>	<u>Horizontal</u>
Thomas & Betts	CKMU
Eaton	WIUMV-1
Hubbell	WP26MH
Leviton	IUM1H-GY

- B. Damp and Wet Location Weatherproof switch cover plates: Fabricated of cast aluminum or cast zinc, sealed water-tight and UL listed for wet locations.

<u>Manufacturer</u>	<u>1 Gang</u>	<u>2 Gang</u>
Appleton	FSK	--
Raco	5100 Series	--
Steel City	SW Series	--

- C. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.

1. Plate securing screws: Metal with head color to match finish plate.
2. Material for Finished Spaces: Smooth plastic, minimum 0.10-inch thick. Refer to "Finishes" above for color.
3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.
4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

2.10 EMERGENCY POWER OFF BUTTONS

- A. Push Button Operators: 30MM, watertight/oiltight, heavy duty, 600V maximum ac/dc, 10A continuous, momentary, non-illuminated, shrouded push button operator. Provide with 1 normally open and 1 normally closed contact block.

<u>Manufacturer</u>	<u>Red Button</u>
Schneider	9001KR1RH13

GE Industrial CR104PBG91R3

Eaton 10250T5021

- B. Push/Pull Button Operators: 30MM, watertight/oiltight, heavy duty, 600V maximum ac/dc, 10A continuous, 2 position maintained, non-illuminated, push/pull button operator. Provide with 1 normally open and 1 normally closed contact block.

Manufacturer Red Button

Schneider 9001SKR9RH13

GE Industrial CR104PBM91R5C

Eaton 10250T5B621

- C. Break Glass Operators: 30MM, watertight/oiltight heavy duty, 600V maximum ac/dc, 10A continuous, push button operator that when disk is broken the operator is released to its open position.. Provide with 1 normally closed contact block, surface or recess mounted, NEMA 1, 4, 4X enclosure with integral break glass hammer and chain.

Manufacturer

Schneider 9001K15

Eaton 10250TBG

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.
- C. Connect wiring devices by wrapping conductors around screw terminals. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.
- E. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.

- F. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.
- G. Install switches with OFF position down.
- H. Install cover plates on all switches, receptacles, and blank outlets.
- I. Locate wiring devices so that the cover plate does not have to be cut to be installed.
- J. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- K. Install cover plates after the wall has been finished (painted, wall paper, etc).
- L. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- M. Provide engraved nameplate on emergency off buttons.
- N. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6' of sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.
- O. Provide type and quantity of normally open and/or normally closed contacts for emergency off buttons to meet the sequence of operations shown.
- P. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

3.2 GENERAL

- A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the Architect.
- B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.
- C. Provide twist-locking type receptacles or other special type receptacles where indicated the Drawings.

3.3 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that floor boxes are adjusted properly and are flush with the finished surface.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that openings in access floor are in proper locations.

3.4 PREPARATION

- A. If required, provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from in and around outlet boxes.

3.5 MOUNTING HEIGHTS

- A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".
- B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.
 - 1. Receptacles:
 - a. General:
 - 1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
 - 2) Where Installed horizontally, install neutral slot mounted at the top.
 - b. Above counters:
 - 1) Mount vertically.
 - c. Mechanical and electrical equipment rooms and janitors closets:
 - 1) Mount horizontally.
 - d. Garages:
 - 1) Wet location: Mount horizontally.
 - 2) Other locations: Mount vertically.
 - e. Weatherproof exterior receptacles:
 - 1) Mount horizontally.
 - f. GFCI receptacles: Same as general receptacles.
 - g. Isolated ground receptacles: Same as general receptacles.
 - h. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.
 - 2. Switches:
 - a. Above counters: Same as for receptacles.
 - b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.
 - c. Walls with wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.
 - 3. Telephone/Data Outlet Boxes:
 - a. General: Match mounting height of adjacent wiring device listed above.
 - 4. Emergency Power Off Buttons and Break Glass Operators:
 - a. General: Match requirements of switches listed above.
 - b. Wall-mounted telephone: 40 inches above finished floor.

3.6 IDENTIFICATION

- A. Label all devices fed down stream of GFCI protected receptacles as "GFCI PROTECTED".
- B. Comply with Division 26 Section "Identification for Electrical Systems."
 - a. .
 - b. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.

3.7 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
- D. Test all wiring devices for electrical continuity and proper polarity of connections.
- E. Test each GFCI receptacle device for proper operation.
- F. Correct wiring devices incorrectly installed.
- G. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

3.8 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.9 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

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SECTION 16150 (262813) - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Cartridge fuses rated 600-V ac and less for use in:
 - a. Control circuits
 - b. Enclosed switches
 - c. Panelboards
 - d. Switchboards
 - e. Enclosed controllers
 - f. Motor-control centers.
 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type:
 - a. Enclosed switches
 - b. Fuseholders
 - c. Panelboards.
 3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
 4. Spare-fuse cabinets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper if available.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. All items requested under "Product Data".

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.4 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C) apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following]:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Mersen Electrical Power
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- C. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- D. Install spare-fuse cabinet(s).

3.2 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance:
 - a. Greater than 600A:
 - 1) Class L, time delay
 - b. 600A or less:
 - 1) Class RK1, time delay
 - 2. Feeders:
 - a. Greater than 600A:
 - 1) Class L, time delay
 - b. 600A or less:
 - 1) Class RK1, time delay
 - 3. Motor Branch Circuits:
 - a. Class RK1 time delay
 - 4. Other Branch Circuits:
 - a. Class RK1, time delay
 - 5. Control Circuits:
 - a. Class CC fast acting

END OF SECTION

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SECTION 16410 (262816) - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
 7. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 4. Hookstick Handle: Allows use of a hookstick to operate the handle.
 5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

1. Manufacturers: Subject to compliance with requirements, Cooper Bussmann, Inc.
 2. Ferraz Shawmut, Inc.
 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, > with a control power transformer enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
1. Oiltight key switch for key-to-test function.
 2. Oiltight green ON pilot light.
 3. Isolated neutral lug; 100 percent rating.
 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac or 24-V dc coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- H. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered] type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 5. Communication Capability: Circuit-breaker-mounted module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered 120-V ac

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections..
- C. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 16241 (263600) – TRANSFER SWITCHES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Remote annunciation systems.
 - 3. Remote annunciation and control systems.
- B. This section does not include the following:
 - 1. Double throw (manual type) switches. Refer to Section 262816 for this equipment.
 - 2. Medium Voltage Automatic Transfer Switches. Refer to Section(s) 261300 or section 262313 for this equipment.

1.2 RELATED SECTIONS INCLUDING THE FOLLOWING:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.
 - 2. Division 21 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

1.3 SUBMITTALS REQUIRED FOR REVIEW

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 2. Schematic diagrams.
 - 3. Wiring diagrams.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Qualification Data: For manufacturer] [and] [testing agency].
- E. Factory test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 DEFINITIONS

- A. Closed Transition (Make-Before-Break): In a switching device, a configuration in which the new connection path is established before the previous contacts are opened. This prevents the switched path from ever seeing an open circuit.
- B. Open Transition (Break-Before-Make): A switch that is configured to break (open) the first set of contacts before engaging (closing) the new contacts. This prevents the momentary connection of the old and new circuit paths together.
- C. Withstand duration: The withstand rating value is the level of fault current that must be withstood for a specified length of time, i.e., 42000 amps at 3 cycles.
- D. Level 1 Equipment: Level 1 is the more stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system, including the transfer equipment could result in loss of human life or serious injury.
- E. Level 2 Equipment: Level 2 is the less stringent NFPA emergency life safety requirement and is imposed when failure of the emergency system including the transfer equipment is less critical to human life safety.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA ICS 1.
- D. Comply with NFPA 70.
- E. Comply with NFPA 99.
- F. Comply with NFPA 110.
- G. Comply with UL 1008 unless requirements of these Specifications are stricter.
- H. Installed equipment must be UL listed and bear the UL label.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the Transfer Switch that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
- B. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
- C. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a.
 - b. Emerson; ASCO Power Technologies, LP.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Voltage and Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated. Voltage ratings shall be consistent with applications from 115 volts AC to 600 volts and single or three phase as required by the application. Current ratings and the number of poles shall be as indicated on the plans.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Where the transfer switch internal fault-current protection can not exceed the indicated fault-current values, an enclosed fused switch with current limiting fuses shall be installed ahead of the transfer switch.
- C. Controls: Solid State control having repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C. All internal controls components shall be accessible from the equipment front.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. [Neutral Switching. Where four-pole switches are indicated, provide overlapping neutral contacts.
- H. Neutral Terminal: Solid and fully rated bus bar, unless otherwise indicated.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. All factory wiring shall be accessible from the equipment front. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated. Power terminals shall be rated for 90 degree C and copper or aluminum cable.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: General-purpose NEMA 250, Type [1] [3R] [12], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.
- K. Bus and Wiring: All Bus and cable /control wire shall be copper.
- L. Cable Entry: Cable entry shall be from the top and bottom.
- M. Service Entrance Rating: Where indicated on the plans, the Automatic transfer switch shall be UL rated for use as service entrance equipment.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- H. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 3. Frequency: Monitor the frequency of the incoming normal power circuit. For the normal source, initiate transfer if the frequency varies more than 5% from the rated nominal value. For the emergency source, inhibit transfer if the normal source circuit frequency varies more than 5% from the rated nominal value.
 4. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 5. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 6. Test Switch: Simulate normal-source failure.
 7. Switch-Position Pilot Lights: Indicate source to which load is connected.
 8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 11. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FACTORY TESTS:

- A. The Automatic Transfer Switch and Bypass Isolation Switch shall be factory tested to verify compliance with these specifications and ensure proper operation

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.

D. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.

E. Coordinate tests with tests of generator and run them concurrently.

- F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 16450 (262200) - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1500 kVA:
 - 1. Distribution transformers.

1.2 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, technical certification sheets and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.
 - 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Qualification Data: For testing agency.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."
- E. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- F. All transformers shall be UL listed and bear the UL label.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. ACME Electric Corporation; Power Distribution Products Division
 - 3. General Electric Company.
 - 4. Siemens Energy & Automation, Inc.

5. Hammond Company
6. Sola/Hevi-Duty
7. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: One leg per phase. Cores shall be constructed of high grade, non-aging silicon steel. The core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor or strap sized in accordance with UL and NEC requirements. The neutral shall be brought to a stud to facilitate the required external grounding of the secondary
- C. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Aluminum.
- D. Connections to transformers shall be by flexible metal conduit and using flexible couplings.
- E. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- F. Wiring/Terminations:
 1. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs.
 2. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.
 3. Lug kits shall be provided by the Manufacturer of the transformer.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Enclosures: Unless otherwise specified, transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. Enclosures shall have a baked polyester powder coat finish-gray in color and suitable for interior or exterior applications. Enclosures shall be constructed so that there are no exposed live parts. Enclosures shall have a removable front cover to allow access to internal parts and wiring terminations
 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
 2. Transformer locations:
 - a. Dry locations:
 - 1) Ventilated
 - 2) NEMA 250, Type 2.
 - b. Damp or wet:
 - 1) Ventilated. Provide weather shields over ventilation openings.
 - 2) NEMA 250, Type 3R.
 - c. Corrosive locations:
 - 1) Totally enclosed, non-ventilated
 - 2) NEMA 250, Type 4X, stainless steel

3. The maximum temperature of the enclosure shall not exceed 90 degrees C.
 4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: Gray.
- E. Taps for Three-phase Transformers smaller than 24 kVA and all single phase transformers: Two 5 percent taps below rated voltage.
- F. Taps for Transformers 25 kVA through 500 kVA: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- G. Taps for Transformers 501 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class for transformers less than 15 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Insulation Class for transformers 15 kVA and larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature
- J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment" efficiency levels.
 2. Tested in accordance with federal law 10 CFR Part 431.
- K. Mounting Methods.
1. Transformers 75 KVA and larger shall be floor mounted unless indicated otherwise. Transformers 45 KVA and smaller may be wall mounted where wall construction is suitable for the load. Floor mounted transformers shall be securely bolted to a 4 inch house keeping pad with vibration isolation pads. Wall mounted or suspended transformers shall have a means of isolating vibration from the support.
 2. Transformers up through 1000 KVA shall be mounted on elastomeric vibration isolation pads. Pad shall be constructed of neoprene, rubber, glass fiber, or a combination thereof. Pads shall be "ribbed" or "waffled" in texture. Pads shall be selected for smallest durometer (hardness), preferably less than 50. Deflection of pad shall be .25" static minimum. Stack pads until the desired deflection is achieved.
 3. Wall Mounting: Manufacturer's standard brackets.
 4. Suspended Mounting: See transformer mounting detail on plans.
- L. Low-Sound-Level Requirements: Maximum sound levels (NEMA ST 20), when factory tested according to IEEE C57.12.91, as follows:
1. 9 kVA and Less: 40 dBA
 2. 30 to 50 kVA: 45 dBA
 3. 51 to 150 kVA: 50 dBA
 4. 151 to 300 kVA: 55 dBA
 5. 301 to 500 kVA: 60 dBA
 6. 501 to 700 kVA: 62 dBA
 7. 701 to 1000 kVA: 64 dBA
 8. 1001 to 1500 kVA: 65 dBA

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to ANSI C57.12.01 and IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

2.6 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. Ratio tests at the rated voltage connection and at all tap connections
 - 2. Polarity and phase relation tests on the rated voltage connection
 - 3. Applied potential tests
 - 4. Induced potential test
 - 5. No-load and excitation current at rated voltage on the rated voltage connection

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Use flexible conduit under the provisions of Division 26 Section "Raceways and Boxes for Electrical Systems" for connections to transformer case. Minimum flexible conduit length shall be two (2) feet.

- D. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 16251 (264113) - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for UL 96A Master Labeled lightning protection system consisting of air terminals on roofs, roof mounted mechanical equipment, stacks, bonding of structure and miscellaneous metal objects; Grounding electrodes; and interconnecting conductors.
- B. System Design: Contractor shall perform all calculations and develop all plan and detail drawings required, in conjunction with these specifications, for installation of a complete and fully functional lightning protection system.
- C. All “Out buildings” in future phase shall be included.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 1. Division 26 Section “General Electrical Requirements”.
 - 2. Division 26 Section “Common Work Results for Electrical”.
 - 3. Division 26 section “Grounding and Bonding for Electrical Systems”.
 - 4. Division 26 Section “Raceway and Boxes for Electrical Systems”.
 - 5. Division 26 Section “Surge Protective Devices”.
- B. Applicable Codes and Standards
 - 1. NFPA 70 – National Electrical Code
 - 2. UL 96 – Lightning Protection Components
 - 3. UL 96A – Installation requirements for Lightning Protection Systems
 - 4. NFPA 780 – Lightning Protection Systems
 - 5. LPI 175 – Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems

1.3 DEFINITIONS

- A. The following definitions apply to terms used in this section:
 - 1. Air Terminal: A strike termination device that is a receptor for attachment of flashes to the lightning protection system and is UL listed for that purpose.
 - 2. Bonding: An electrical connection between an electrically conductive object and a component of a lightning protection system that is intended to significantly reduce potential differences created by lightning currents.
 - 3. Class I Materials: Lightning conductors, air terminals, ground terminals, and associated fittings required by NFPA 780 for protection of structures not exceeding 75 feet (23 meters) in height.
 - 4. Class II Materials: Lightning conductors, air terminals, ground terminals, and associated fittings required by NFPA 780 for the protection of structures exceeding 75 feet (23 meters) in height.
 - 5. Bonding conductor: A conductor intended to be used for equalization between grounded metal bodies and a lightning protection system.
 - 6. Main conductor: A conductor intended to be used to carry lightning currents between strike termination devices (air terminals) and ground terminals.
 - 7. UL: Underwriters Laboratories, Inc.
 - 8. LPI: Lightning Protection Institute

1.4 SUBMITTALS

- A. Product Data: Submit product data showing dimensions and materials of each component including listing in accordance with UL 96A.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system showing layout of air terminals grounding electrodes, and bonding connections, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, conductor sizes, roof and/or floor penetrations, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
 - 3. Layout and installation drawings shall be fully coordinated with other trades. Failure of the lightning protection contractor to perform this coordination shall not relieve said contractor from properly completing the work.
- C. Qualification Data: For qualified manufacturer. Include data on listing or certification by UL.
 - 1. Manufacturer: A company specializing in lightning protection equipment with minimum 3 years documented experience and membership in good standing with the Lightning Protection Institute.
- D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- E. Field quality-control reports.
- F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- G. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Ground loop conductor.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Certified by UL, trained and approved for installation of units required for this Project.
 - 2. The contractor shall be recognized as being regularly engaged in the design and installation of lightning protection systems with a minimum of 3years documented experience.
 - 3. Include documentation of certification and experience with all submitted bids.
- B. System Certificate:
 - 1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. All materials used in the installation shall be new and shall comply in weight, size, and composition with UL 96 and NFPA 780. Materials shall be labeled or listed by UL for use on lightning protection systems.
- B. Roof-Mounted Air Terminals: NFPA 780, Class II, aluminum or copper unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. East Coast Lightning Equipment Inc.
 - b. ERICO International Corporation.
 - c. Harger.
 - d. Heary Bros. Lightning Protection Co. Inc.
 - e. Independent Protection Co.
 - f. Preferred Lightning Protection.
 - g. Robbins Lightning, Inc.
 - h. Thompson Lightning Protection, Inc.
 - 2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
 - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
- C. Main and Bonding Conductors: Copper and Class II.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

2.2 SURGE PROTECTIVE DEVICES

- A. Surge Protective Devices SPD's required to meet UL 96A for UL Master Labeling shall be as specified in Division 26 Section "Surge Protective Devices".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with two direct paths from air terminals to ground connections. Avoid sharp bends. Follow the manufacturer's written installation instructions.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.
- D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

- E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
 - 1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
- F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- G. Air Terminals on Mechanical Equipment: Air terminals on mechanical equipment shall be mounted such that maintenance operations can be performed without relocation of the air terminal or interconnecting conductors.
- H. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION

SECTION 16264 (264313) – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes Surge Protection for:
 - 1. Surge Protection Devices Internally Mounted In Switchboards
 - 2. Panelboard Suppressors Internally Mounted In Panelboards
- B. Section includes field-mounted SURGE Protective Devices (SPD's) for low-voltage (120 to 600 V) power distribution and control equipment. Device type ratings shall be:
 - 1. Type 1 - Service Entrances
 - 2. Type 2 - Service entrances or distribution switchboards or panelboards
- C. Refer to Definitions below for clarification of type selection.

1.2 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage Protection Rating. The average of measured limiting voltage before and after Nominal Discharge Testing (In,) rounded up to one of UL's VPR categories (Table 63.1 of ANSI/UL 1449 Third Edition) such as 330 volt, 400 volt, 500 volt, etc. VPR is posted on each device UL label.
- C. In or In or Inominal: Nominal Discharge Current. Peak value of surge current, selected by the manufacturer, through the SPD having current wave shape of 8/20 microseconds where the SPD remains functional after 15 surges. In is posted on the device UL label.
- D. SPD: Surge Protective Device. Previously Transient Voltage Surge Suppressor (TVSS), a broad class of protective devices, installed parallel with the distribution panel or service disconnect, meant to protect downstream electrical distribution equipment from the effects of high voltage surges on the line.
- E. MCOV: Maximum Continuous Operating Voltage. The maximum continuous operating voltage rating of a Metal Oxide Varistor (MOV) that can be applied without the MOV being damaged and/or destroyed by thermal runaway. MCOV is posted on the device UL label.
- F. SCCR: Short Circuit Current Rating. The maximum current rating the SPD can sustain without being damaged and/or destroyed. SCCR is posted on the device UL label.
- G. SPD Type:
 - 1. TYPE 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 1 devices are required for Master Certification of Lightning Protection System installations under UL 96A.
 - 2. TYPE 2: Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch circuit panel.
 - 3. TYPE 3: Point-of-utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, e.g., cord-connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (10 meters or 30 feet) is exclusive of conductors provided with or used to attach SPD's.
 - 4. TYPE 4: Component SPDs, including discrete components as well as component assemblies for installation on panelboards or control panels.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate SPD devices with Division 26 Section "Electrical Power Monitoring and Control."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include model number, SPD type, system voltage, phases, modes of protection, voltage Protection rating (VPR), and Nominal Discharge Current (I_n), and accessories required.
- B. Product Certificates: For SPD devices, from manufacturer.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.
- E. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL) as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with NEMA LS 1.
- D. Comply with UL 1283 and ANSI/ UL 1449 Third Edition.
- E. Comply with NFPA 70.
- F. The SPD shall be compliant with the restrictions of the Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Refer to Division 26, Section "General Electrical Requirements".
- B. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS (INTERNALLY AND EXTERNALLY MOUNTED SPD'S AT SERVICE ENTRANCE GEAR)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB USA.
 2. AC Data Solutions.
 3. Advanced Protection Technologies Inc. (APT).
 4. Atlantic Scientific.
 5. Current Technology Inc.; Danaher Power Solutions.
 6. Danaher Power Solutions; United Power Products.
 7. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 8. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 9. Intermatic, Inc.
 10. LEA International.
 11. Leviton Mfg. Company Inc.
 12. Liebert Corporation; a division of Emerson Network Power.
 13. Northern Technologies, Inc.; a division of Emerson Network Power.
 14. Siemens Energy & Automation, Inc.
 15. Square D; a brand of Schneider Electric.
 16. Surge Suppression Incorporated.
- B. Surge Protection Devices:
1. Comply with UL 1449 Third Edition.
 2. Modular design (with field-replaceable modules) Non-modular design.
 3. Fuses, rated at 200-kA interrupting capacity.
 4. Fabrication using bolted compression lugs for internal wiring.
 5. Redundant suppression circuits.
 6. Redundant replaceable modules.
 7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 8. LED indicator lights for power and protection status.
 9. Audible alarm, with silencing switch, to indicate when protection has failed.
 10. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 11. Four-digit transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating, per phase:
1. 200kA per mode/400kA
- D. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Third Edition Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 10kA 20kA per mode.
 2. Type 2 SPD's shall be tested and labeled at 3kA 5kA 10kA 20kA per mode.
- E. Protective Impulse: The SPD shall be tested by application of 15 repetitive impulses of 3000 amps and 6000 volts having an 8x20 microsecond wave shape
- F. Protection modes and UL 1449-Third Edition VPR for grounded wye circuits 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2.2 PANELBOARD SUPPRESSORS (INTERNALLY MOUNTED SPD'S AT PANELBOARD LOCATION)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB USA.
 2. AC Data Solutions.
 3. Advanced Protection Technologies Inc. (APT).
 4. Atlantic Scientific.
 5. Current Technology Inc.; Danaher Power Solutions.
 6. Danaher Power Solutions; United Power Products.
 7. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 8. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 9. Intermatic, Inc.
 10. LEA International.
 11. Leviton Mfg. Company Inc.
 12. Liebert Corporation; a division of Emerson Network Power.
 13. Northern Technologies, Inc.; a division of Emerson Network Power.
 14. Siemens Energy & Automation, Inc.
 15. Square D; a brand of Schneider Electric.
 16. Surge Suppression Incorporated.
- B. Surge Protection Devices:
1. Comply with UL 1449 Third Edition.
 2. Modular design (with field-replaceable modules) Non-modular design.
 3. Short-circuit current rating complying with UL 1449 Third Edition, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
 4. Fuses, rated at 200-kA interrupting capacity.
 5. Fabrication using bolted compression lugs for internal wiring.
 6. Integral disconnect switch.
 7. Redundant suppression circuits.
 8. Redundant replaceable modules.
 9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 10. LED indicator lights for power and protection status.
 11. Audible alarm, with silencing switch, to indicate when protection has failed.
 12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 13. Four Six-digit transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating per phase:
1. 100kA per mode/200kA
- D. Nominal Discharge current (I_n): The SPD shall be tested to meet UL 1449 Third Edition Nominal Discharge Current requirements. All modes of protection shall be tested including any required overcurrent protection.
1. Type 1 SPD's shall be tested and labeled at 10kA 20kA per mode.

2. Type 2 SPD's shall be tested and labeled at 10kA 20kA per mode.

E. Protection modes and UL 1449 Third Edition VPR for grounded wye circuits, 3-phase, 4-wire circuits shall be as follows:

	480Y/277 V	208Y/120 V	600Y/347 V
Line to Neutral	1200	700	1500
Line to Ground	1200	700	1500
Neutral to Ground	1200	700	1500

2.3 ENCLOSURES

A. All SPD Units shall be fully enclosed unless otherwise noted. Provide enclosures suitable for the locations indicated and as described below:

1. Indoor Enclosures:

- a. NEMA 250 Type 1 constructed of a polymer or steel material
- b. NEMA 250 Type 12 constructed of a polymer or steel material with a gasket to exclude dust.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Provide multiple, 30 60 100-A circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

B. SPD device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect any equipment to their sources until SPD devices are installed and connected.

- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION

SECTION 16511 (265100) – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Included in the work of this section are labor, material, and appurtenances required to complete the work of this Section as specified herein, including, but not limited to:
 - 1. Interior light fixtures, lamps, LEDs, reflectors, lenses or faceplates, ballasts, transformers, drivers and power supplies (includes exterior light fixtures normally installed on exterior surfaces of buildings).
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Light fixture supports.
 - 5. Coordination.
 - 6. Quality assurances.
 - 7. Specific requirements.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
- B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.
- C. Division 26 Section "Exterior Lighting” for exterior light fixtures, except those normally mounted on exterior surfaces of buildings.
- D. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
- E. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 SUBMITTALS

- A. General:
 - 1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
 - 2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
 - 3. Prepare portfolios from manufacturer's standard specification sheets, and include the fixture tag indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
 - 4. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
 - 5. Modifications to fixtures shall be in accordance with Architect’s comments.
- B. Product Data: For each type of light fixture, collated and bound in sets, and arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Summary page with the following for each light fixture type

- a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
 - b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.
 2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
 - a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, fixture efficacy and/or efficiency, and verification of indicated parameters.
 - b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
 - 1) Include MacAdam ellipse step information for:
 - a) All interior light fixtures
 - b) Exterior luminaires installed on exterior building surfaces specified with 80 CRI or greater.
 3. Light fixture mounting details, including non-standard outlet boxes.
 4. Construction of light fixture housing and door (if applicable).
 5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
 6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
 7. Light fixture finish and color (if applicable).
 8. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
 - a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
 9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 10. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.
- C. Shop Drawings: Show details of non-standard or custom light fixtures. Indicate dimensions, finish color, including, but not limited to, custom color, weights, methods of field assembly, components, features, accessories, and modifications. Scaled documents shall be provided for custom fixtures.
- D. Submittal Schedule
 1. Within 30 days of Division 26 contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
 2. Within 15 days of “approved” and “approved as noted” shop drawings, contractor shall forward to Architect a guaranteed ship date for each specified fixture.
 3. Within 15 days after contractor’s receipt of “reject and resubmit” or “not approved” shop drawings, contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
 4. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
- E. Control Wiring

- F. Coordination Drawings: Refer to architectural reflected ceiling plans or details for exact location of light fixtures; engineering documents shall not be referenced for exact fixture positions. Contractor shall check and verify dimensions and details on drawings before proceeding with the work. If any question arises about the true meaning of drawings, refer the matter to the Architect, whose decision is final. In no case proceed with work with any uncertainty. Architectural documents shall show and coordinate with assistance from installers of items involved:
1. Light fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for light fixtures will be attached.
 4. Other items in finished ceiling including the following:
 5. Air outlets and inlets.
 6. Speakers.
 7. Sprinklers.
 8. Smoke and fire detectors.
 9. Occupancy sensors.
 10. Access panels.
 11. Perimeter moldings.
- G. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- H. Qualification Data: For agencies providing photometric data for light fixtures.
- I. Field quality-control test reports.
- J. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.
- K. Warranties: Special warranties specified in this Section.

1.4 SUBSTITUTIONS

- A. Refer to Division 26 Section "General Electrical Requirements".
- B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and complete Product Data for the proposed substitute, as defined in SUBMITTALS above, and all other information necessary for an evaluation. Provide interior point-by-point photometric calculations, under both normal and emergency lighting conditions, as applicable, if required by the Engineer. Submit a \$100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.
- C. During the Bid
1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
 2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
 - a. Agents can group only specified fixtures they represent, and
 - b. Only represent in the region where the specification originated, and
 - c. Exclude all fixtures outside their represented lines from the MLP, and
 - d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
 3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.

- D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.
- E. During the construction period, no substitutions shall be considered if product delay is due to contractor's failure to order products in a timely manner after presentation of fixture schedules and specifications. Additional costs associated with air freight or special factory runs to meet schedule due to contractor's error shall be at the expense of contractor.
- F. The Architect/Engineer has the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.5 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature
- C. CFL: Compact Fluorescent
- D. CRI: Color-rendering index.
- E. CU: Coefficient of utilization.
- F. EISA: Energy Independence and Security Act of 2007.
- G. HID: High-intensity discharge.
- H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs
- I. LED: Light Emitting Diode
- J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.
- K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.
- L. LER: Light fixture (Luminaire) efficiency rating.
- M. Light Fixture: Complete light fixture, including ballast housing if provided.
- N. RCR: Room cavity ratio.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 2. Marked for intended use.
- B. Comply with NFPA 70.

- C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- D. Regulatory Agencies: Provide fixtures conforming to nationally- or internationally-recognized accredited testing agencies, such as U.S., ETL, ARL, or others in acceptance with local code enforcement policy.
- E. Electrical Components and Devices: Provide only fixtures that comply with National Electric Code (NEC), and in particular to Section 410. All ceiling recessed fixtures, whether indicated in a catalog number or not, shall be equipped with an integral thermal protection device.

1.7 COORDINATION

- A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.
- B. Coordinate layout and installation of light fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including, but not limited to, HVAC equipment, fire-suppression system, and partition assemblies. Contractor shall arrange his installation in proper relation to other work so that there shall be no interference, damage or delay to other trades' work
- C. Give ample notice of any special openings or rough-in work required for placing electrical/lighting work so as to avoid cutting or removal of completed work.
- D. Where work of this Section is to be flush or concealed, install it so it does not project beyond finished lines of walls, ceilings or floor surface.
- E. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

1.8 WARRANTY

- A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.10.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.
- B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.
- C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
 - 1. LED Luminaires, including LED modules, arrays and drivers: Five years.
 - 2. LED Lamps: Three years.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Additional light fixtures and accessories as scheduled on the Drawings.
- B. Where light fixtures are specified with tamper proof hardware, provide the Owner with three tools for each different type of hardware.
- 1.10 SPARES
- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Battery and Charger Data: One for each emergency lighting unit.
 4. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
 5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. No substitutions shall be allowed as per Section 1.4.

2.2 LIGHT FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Provide light fixtures as shown on the drawings and/or specified. This shall include all lamps, material and labor to securely hang light fixtures, clean them and make them completely ready for use. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures. Provide additional tie wires connected to structure to conform to applicable seismic requirements where required.
- B. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.
- C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. Manufacturer of recessed fixtures shall provide mounting brackets suitable for connection to ceiling system structure. Modifications to standard mounting brackets shall be coordinated with contractor and delivered with fixture so that no delays to product delivery shall be allowed.
- D. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Minimum gauge of sheet steel to be 18 gauge.
- E. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable. Minimum gauge of sheet steel to be 22 gauge.
- F. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

- G. Metal Parts: Free of burrs and sharp corners and edges.
- H. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- K. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- L. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.
- M. Fixture Finishes:
 - 1. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings, except chromium-plated or stainless steel parts, an even coat of high-grade meth/acrylate lacquer or transparent epoxy.
 - 2. For corrosive or salt water environments, manufacturer shall provide fixtures with low copper/zinc cast aluminum (AB-47100 aluminum with less than 0.6% copper – classified for corrosive areas) housings to prevent salts from “pitting” aluminum housing. Manufacturer shall provide, in addition to or in lieu of, AB-47100 aluminum, ion added or pre-anodized polyester powder cast finish for “marine grade” applications. Manufacturer shall otherwise provide all stainless steel housing in conjunction with stainless steel hardware.
 - 3. Recessed downlights in corrosive or salt water interior environments shall be equipped with a “natatorium” finish comprised of a zinc-chromated and phosphated process, then powder-coated on the exterior of the housing.
- N. Reflectors:
 - 1. Provide aluminum reflectors or reflecting cones for downlight style fixtures comprised of #12 aluminum reflector sheet, 0.57 inch (15 gauge) or heavier and free of tool-making indentations, including spinning lines caused by assembly techniques. All reflectors shall be of first-quality, anodized finish :Alzak” with specular or semi-specular finish and color as selected. Provide specular reflectors with no apparent brightness above 45 degrees from Nadir and semi-specular, diffuse reflectors with no apparent brightness above 75 degrees from Nadir.
- O. Mounting hardware and trims:
 - 1. Coordinate as need to suit ceiling conditions.
 - 2. Light fixtures near or in contact with insulation shall comply with code.

3. Maintain a 3” minimum working clearance between non-IC rated light fixture housings and insulation on all adjacent ductwork, piping, walls and ceilings.
- P. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
 - a. "USE ONLY" and include specific lamp or LED type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires. Indicate maximum allowed wattage.
 - d. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.
 - e. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - g. CCT and CRI for all luminaires.

2.3 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
 3. Master/Remote Sign Configurations:
 - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply, ballast and battery for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.4 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 DRIVERS FOR LED LUMINAIRES

- A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
 1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Power Factor: 0.90 or higher at full load.
 5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 6. Driver shall operate with maximum sustained variations of +/-10% input voltage and frequency with no damage to driver.
 7. Driver output shall be regulated to maximum +/- 5% published load range or requirements of downstream LED fixture.
 8. LED Current Crest Factor: 1.5 or less.
 9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
 10. Meets EN610000 for input harmonics.
 11. ROHS Compliant.
- B. Dimming Drivers:
 1. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
 - a. Luminaires: 100 to 10 percent of rated lumens.
 - b. Lamps: 100 to 20 percent of rated lumens.
 2. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and LED indicated.
 4. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.6 LED LAMPS AND LUMINAIRES

- A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 80 CRI minimum and 3000K CCT.
- B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values or as indicated in the Light Fixture Schedule, whichever is more stringent. All LEDs used for same fixture type throughout the project to originate from same production bin.
- C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% maintained initial-rated lumens at average rated life of as follows:
 - 1. LED lamps: 20,000 hours
 - 2. LED luminaires: 50,000 hours
- D. ROHS compliant
- E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Cree, Nichia, Osram or Xicato LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desirable.

2.7 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

- A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system. Where equipment is not indicated as plenum rated, provide an additional enclosure for the device(s) suitable for the installed environment.

2.8 LIGHT FIXTURE SUPPORT COMPONENTS

- A. Comply with Sections "260548 Seismic Controls for Electrical" and "260529 - Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.9 RETROFIT KITS FOR FLUORESCENT LIGHT FIXTURES

- A. Comply with UL 1598 listing requirements.
 - 1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed light fixtures by improving reflectivity of fixture surfaces.
 - 2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

2.10 TRANSFORMERS FOR LOW VOLTAGE FIXTURES

- A. Provide transformers to low voltage lamps which are suitable for the electrical characteristics of the supply circuits to which they are to be connected. For remote electronic or magnetic transformers, contractor shall remote transformers so as to reduce voltage drop. For 25 amp low-voltage linear systems, contractor shall not daisy-chain 25A loaded runs together. Contractor shall provide home-run from end of run to remote transformer.

2.11 COLD CATHODE TUBING

- A. Surface or recessed cold cathode shall be installed at locations indicated on drawings to form a continuous line of light, without noticeable breaks at tube ends. Recommended porcelain socket ends and support elements shall be illustrated on shop drawing submittal. Tube colors shall be selected by Architect, lighting designer, or interior designer, based on manufacturer's standard palette of colors and shall be indicated on Fixture Schedule. Contractor shall not order cold cathode tubes without written confirmation of said color by Architect or Owner based on sample, mockup, or other verification means. Failure of contractor to obtain written approval of color shall hold contractor solely responsible for financial obligations to provide approved color.
- B. Lamps shall be made from 1-inch diameter glass. Lamps showing end darkening, stains, discolorations, spiraling or sputtering shall be rejected. Manufacturer shall comply with NEC regulations regarding lighting service over or under 1000 volts. For said systems requiring under 1000V, manufacturer shall supply only 200MA ballasted cold cathode system.
- C. Bidding cold cathode manufacturers shall be U.L. IFAY 48 listed and shall have an approved IFAY 48 number given by U.S. prior to bidding. WZBL installers of cold cathode shall be disqualified. Failure to comply with specifications for U.L. IFAY manufacturers shall deny payment to WZBL manufacturer and contractor. Contractor shall be financially and legally responsible for providing an IFAY 40 system.
- D. Shop drawings shall be submitted for approval. These drawings shall include scale plans and details showing the method of installation of ballasts or transformers, intermediate feeds and connections. A copy of this approved shop drawing shall be submitted to the Owner for his use in lamp replacement and maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Light Fixtures: All work shall be executed to present a neat appearance. Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- D. Support for Light Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from light fixture corners.
 2. Support Clips: Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 4. Install at least one independent support rod or wire from structure to a tab on light fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Light Fixture Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.
 4. Decorative pendant mounted light fixtures
 - a. Provide cord and/or stem lengths to match elevations above finished floor as indicated on architectural elevations. If architectural elevations do not indicate suspension heights, coordinate with Architect to determine final suspension heights. Regardless, contractor shall not field cut pendants or order rigid stems without elevation approval from Architect. Pendant suspensions on electrical documents are for reference only.
 - 1) Cord-mounted: Manufacturers shall supply luminaires with flexible, field cutting cords. Contractor shall field cut cords as required.
 - 2) Field-cutable, rigid-stem mounted: Manufacturers shall supply luminaires with field cutting rigid stems. Contractor shall field cut stems as required.
 - 3) Factory-cut rigid stem mounted: Contractor shall provide rigid stem dimensions to the manufacturer as required.
 - b. Junction boxes used to feed light fixtures shall be covered by manufacturer supplied canopy plates.
- F. Installation within non-standard ceilings, including, but not limited to, wood and metal ceilings.
1. For recessed downlight light fixtures, specification is based on standard throats to accommodate ceiling thicknesses of 3/4" or less. If non-standard ceiling (such as wood, thickened gypboard ceilings and metal plank type) require throats greater than 3/4", modifications to manufacturer's standard 3/4" throat shall be determined by Architect and Contractor prior to shop drawing submission.
 2. For light fixtures recessed into metal ceilings, rigidly support light fixture to ensure that trim fits flush with ceiling plane.
- G. Manufacturer shall supply contractor with a complete list of component elements to comply with design intent for either 20-amp (flexible low voltage track systems or line voltage track) or 50-amp bus bar track systems. Contractor shall install track systems based on design requirements outlined herein or Light Fixture Schedule.
- H. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."
- I. Through wiring of recessed light fixtures, in suspended ceilings, is not permitted. Connect each light fixture by a whip to a junction box. The whip shall be of sufficient length to allow the light fixture to be relocated within a 6-foot radius.
- J. Wall Mounted Light fixtures
1. Unless otherwise noted, conceal all raceways and back boxes for wall mounted light fixtures. Coordinate all wall-mounted light fixtures with interior elevations. Where specific elevations or dimensions are not indicated, verify the correct location with Architect prior to installation. Contractor shall supply structure to support weight of fixture.

- K. Contractor shall construct light coves according to architectural details. Contractor shall ensure, unless otherwise directed, that top of fixture lamp is flush with top of cove lip. Contractor shall provide blocking as needed under fixture to ensure stated requirement.
- L. Auxiliary Devices for low voltage and LED Fixtures
 1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
 2. In public areas or other areas where remote device visibility is undesirable, install device where concealed from view, well ventilated and accessible. Provide access panels as required.
 3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
 4. Properly support remote lighting devices, including transformers, power supplies, and drivers, per Code and manufacturer's recommendations.

3.3 MULTI-LEVEL SWITCHING

- A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.
- B. The lighting design for this project has included multi-level (inboard/outboard) switching. Where indicated, 3-lamp light fixtures shall have the center lamp switched from the switch nearest the door and the outer 2 lamps switched from the other switch.
- C. Where indicated, 4-lamp light fixtures shall have the outer 2 lamps switched from one switch and the center 2 lamps shall be switched from the other switch.

3.4 DIMMING

- A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
 1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
 2. 2-Wire dimming – two line voltage conductors plus ground
 3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
 4. DALI – two low voltage conductors and two line voltage conductors plus ground
 5. Proprietary digitally addressable – as required per the manufacturer
 6. DMX – two line voltage conductors plus ground and DMX cabling
- B. Coordinate light fixture and control device dimming types for compatibility.

3.5 COORDINATION

- A. Light fixtures shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings for exact locations.
- B. Coordinate the installation and location of light fixtures with other work and all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.
- C. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.
- D. Coordinate final light fixture locations in walk-in coolers and freezers with refrigeration coils and other trades.

- E. Wall-Mounted Light fixtures
 - 1. Coordinate all wall-mounted light fixtures with the architectural features of the building. Where specific elevations or dimensions are not indicated, verify the correct location with the Architect prior to beginning any work.

3.6 ADJUSTING

- A. Contractor shall adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.
- B. Where required, focusing shall be done during hours of darkness. Upon notification by contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with contractor as to a mutually agreed upon time to complete focusing. Failure of contractor to notify Architect during substantial completion will result in failure to comply with specifications.

3.7 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.
- C. Upon completion of the installation of light fixtures, and after building circuits have been energized, energize lighting branch circuits to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. At the time of final acceptance of this project by the Owner, ensure that all lamps are in working order and all light fixtures are fully lamped.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.9 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION

SECTION 16521 (265600) - EXTERIOR AREA LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting equipment:
 - 1. Exterior LED light fixtures with LED modules and drivers.
 - 2. Light-fixture-mounted photoelectric relays.
 - 3. Poles and accessories.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 26 Section "General Electrical Requirements" for general requirements and related documents that apply to this Section.
- B. Division 26 Section "Common Work Results for Electrical" for raceways, conductors, cables, and cords.
- C. Division 26 Section "Grounding and Bonding for Electrical Systems"
- D. Division 26 Section "Raceway and Boxes for Electrical Systems.
- E. Division 26 Section "Underground Ducts and Raceways for Electrical Systems"
- F. Division 26 Section "Identification for Electrical Systems"
- G. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
- H. Division 26 Section "Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
- I. Division 26 Section "Wiring Devices" for devices installed in poles.
- J. Division 26 Section "Fuses"
- K. Division 26 Section "Enclosed Switches and Circuit Breakers"
- L. Division 26 Section "Lightning Protection for Structures"
- M. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 SUBMITTALS

- A. General:
 - 1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and

- monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
- B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
 2. Modifications to fixtures shall be in accordance with Architect's comments.
- C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Summary page with the following for each light fixture type
 - a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
 - b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.
 2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
 - a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, effective projected area, fixture efficacy and/or efficiency, and verification of indicated parameters.
 - b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
 - 1) Include MacAdam ellipse step information for luminaires specified with 80 CRI or greater.
 3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.
 4. Construction of light fixture housing and door (if applicable).
 5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
 - a. For dimming ballasts, also include dimming type technology and dimming range/limits.
 6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
 - a. For dimming LED, also include dimming type technology and dimming range/limits.
 7. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
 - a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
 8. Details of attaching light fixtures and accessories.
 9. Details of installation and construction.
 10. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
 - a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 11. For pole-mounted LED area lighting fixtures, IES-TM-21 LED luminaire lifetime and lumen maintenance projections.
 12. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.
 13. Photoelectric relays.
 14. Materials, dimensions, and finishes of poles.

15. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.
16. Anchor bolts for poles.
17. Manufactured pole foundations.

D. Delegated-Design Submittals for Pole-Mounted Area Lighting: Submit the following documents, signed and sealed by a qualified professional engineer:

1. Structural analysis data and calculations used for pole selection and foundations.
 - a. Manufacturer Seismic Qualification Certification: Submit certification that lighting components and their mounting and anchorage provisions are designed to remain in place with out separation of any parts when subject to seismic forces defined in Division 26 Section "Vibration and Seismic and Seismic Controls for Electrical Systems" Include the following:
 - 2) Basis for Certification: Indicate whether withstand certifications are based on actual test of assembled components or calculation.
 - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - b. Manufacturer Wind-Load Strength Certification: Submit certification that selected total support system, including poles and equipment anchorage devices, complies with AASHTO LTS-4 or as required by the local authority having jurisdiction, whichever is more stringent, for location of project.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Design calculations for the following:
 - a. Design calculations for determination of poured-in-place concrete foundation size and reinforcement
4. Shop Drawings:Submittal Schedule
 - a. Within 30 days from Division 26 Contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.
 - b. Within 15 days of "approved" and "approved as noted" shop drawings, Contractor shall forward to Architect a guaranteed ship date for each specified fixture.
 - c. Within 15 days after Contractor's receipt of "reject and resubmit" or "not approved" shop drawings, Contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
 - d. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
5. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
6. Wiring Diagrams: Power and control wiring.

E. Qualification Data: For Installer.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For light fixtures to include in operation and maintenance manuals.

H. Warranty: Special warranties specified in this Section.

1.4 SUBSTITUTIONS

A. Refer to Division 26 Section "General Electrical Requirements".

- B. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including cut sheets, photometric data, and all other information necessary for an evaluation. Provide interior point-by-point calculations if required by the Engineer. Submit a \$100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.
- C. During the Bid
 - 1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
 - 2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
 - a. Agents can group only specified fixtures they represent, and
 - b. Only represent in the region where the specification originated, and
 - c. Exclude all fixtures outside their represented lines from the MLP, and
 - d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
 - 3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.
- D. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.
- E. The Architect/Engineer have the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.5 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature
- C. CRI: Color-rendering index.
- D. CU: Coefficient of utilization.
- E. EISA: Energy Independence and Security Act of 2007.
- F. HID: High-intensity discharge.
- G. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs
- H. LED: Light Emitting Diode
- I. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.
- J. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

- K. LER: Light fixture efficacy rating.
- L. Light fixture: Complete light fixture, including ballast housing if provided.
- M. LLD: Lamp Lumen Depreciation.
- N. LLF: Light Loss Factor.
- O. Luminaire: Complete lighting fixture, including ballast housing if provided.
- P. Pole: Light fixture support structure, including tower used for large area illumination.
- Q. Standard: Same definition as "Pole" above.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.
- B. Light Fixture Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.7 COORDINATION

- A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.
- B. Coordinate layout and installation of light fixtures, poles, foundations, and underground raceway system with other above- and below-grade site construction and utilities. Notify Architect/Engineer of conflicts before proceeding with the Work.

1.8 WARRANTY

- A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.12.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.
- B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.

- C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
 - 1. LED Luminaires, including LED modules, arrays and drivers: Five years.
 - 2. LED Lamps: Three years.

- D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Light fixtures: Free from defects in materials and workmanship (excluding fuses and lamps) for a period of 5 years from date of Substantial Completion.
 - 2. Warranty Period for Lamps: Replace lamps and fuses that fail within 6 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 6 months from date of Substantial Completion.
 - 3. Warranty Period for Poles: Repair or replace light poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than 5 years from date of Substantial Completion.
 - 4. Alignment Warranty: Accuracy of alignment of light fixtures shall remain within specified illuminance uniformity ratios for a period of 5 years from date of successful completion of acceptance tests. Realign fixtures that become misaligned during the warranty period. Replace alignment products that fail within the warranty period. Retest distribution to verify proper realignment.
 - 5. Warranty for Pole-Mounted LED Area Lights: Light fixture (including LEDs and drivers) and pole will be free of defects in material and workmanship for a period of ten years from date of product purchase.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation.
- D. Handle all poles with web fabric straps.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Additional light fixtures, poles, and accessories as scheduled on the Drawings.
- B. Where light fixtures are specified with tamper proof hardware, provide the Owner with three tools for each different type of hardware.

1.11 SPARES

- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 5 for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts and/or Drivers: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 2 for every 20 of each type and rating installed. Furnish at least one of each type.
5. Fuses: 10 for every 100 of each type and rating installed.

PART 2 - PRODUCTS AND MATERIALS (PROVIDED BY OTHERS)

2.1 MANUFACTURERS

- A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT FIXTURES, GENERAL REQUIREMENTS

- A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.
- C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.

- L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.
- M. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.
- N. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping. Where indicated, match finish process and color of pole or support materials.
- O. Factory-Applied Finish for Aluminum Light Fixtures: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: As indicated on the Light Fixture Schedule.
- P. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
 - a. "USES ONLY" and include specific lamp or LED type.
 - b. Lamp diameter code (T-4, T-5, T-8), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.
 - e. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
 - f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - g. For LED luminaires, includes CCT and CRI.

2.3 LAMPS GENERAL

- A. Unless specific manufacturers and lamp types are called for in the Light Fixture Schedule, all lamps provided for this project shall be by the same manufacturer. Lamps shall be manufactured by:
 - 1. Eiko
 - 2. General Electric
 - 3. Osram/Sylvania
 - 4. Philips
 - 5. Soraa
 - 6. Venture
- B. All lamps shall be new and shall be delivered to the project in manufacturer's original sealed package.
- C. Substitutions of specific lamp manufacturer as addressed in Fixture Schedule shall not be allowed. Costs associated with re-lamping due to non-compliance with specification, for both labor and material costs, shall be the sole responsibility of the contractor. For those fixtures with lamp included in fixture, contractor shall coordinate with manufacturer to ensure only approved lamp(s) is (are) installed. Lamp manufacturers indicated on Fixture Schedule are for reference. Where required, contractor shall coordinate with Owner regarding national purchasing agreement of specific lamp manufacturers. Purchasing of lamps, whether

through competitive bidding of listed manufacturers or proprietary supply, shall be at the discretion of the Owner.

2.4 DRIVERS FOR LED LUMINAIRES

- A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Power Factor: 0.90 or higher at full load.
 5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 6. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.
 7. Driver output shall be regulated to +/- 5% published load range.
 8. LED Current Crest Factor: 1.5 or less.
 9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
 10. Meets EN610000 for input harmonics.
 11. ROHS Compliant.
 12. Suitable for use in outdoor light fixtures.
 13. Dimming Drivers
 - a. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
 - 4) Luminaires: 100 to 10 percent of rated lumens.
 - 5) LED Lamps: 100 to 20 percent of rated lumens.
 - b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
 - c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.
 - d. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.5 LED LAMPS AND LUMINAIRES

- A. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.
- B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values for color as indicated in the Light Fixture Schedule.
- C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:
1. LED outdoor pole mounted area lights: 100,000 hours
 2. LED lamps: 20,000 hours
 3. Other LED luminaires: 50,000 hours
- D. ROHS compliant
- E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram LEDs;

additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desirable.

2.6 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

- A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

2.7 LIGHT FIXTURE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
 - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.8 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of light fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Light Fixture Attachment Provisions: Comply with light fixture manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M or ASTM A 153/A 153M unless stainless-steel items are indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, 3000-psi (28-day minimum compressive strength, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.9 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
 - 1. Shape: As indicated in the Light Fixture Schedule.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Pole-Top Tenons: Fabricated to support light fixture or light fixtures and brackets indicated, and securely fastened to pole top.
- C. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- F. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- G. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As indicated by manufacturer's designations

2.10 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 LIGHT FIXTURE INSTALLATION

- A. Install lamps in each light fixture.
- B. Fasten light fixture to indicated structural supports.
- C. Adjust light fixtures that require field adjustment or aiming.
- D. Baffles and Louvers for Spill Light Correction: Install on lighting fixtures with fasteners provided by the manufacturer. Install and adjust to correct out-of-limit spill-light and glare measurements.
- E. Auxiliary devices for low voltage and LED fixtures installation
 - 1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
 - 2. In public areas or other areas where remote device visibility is undesirable, install device where concealed from view, well-ventilated and accessible. Provide access panels as required.
 - 3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.

4. Properly support remote lighting devices, including, but not limited to, transformers, power supplies, and drivers, per Code and manufacturer's recommendations.
5. Provide enclosures suitable for installation environment as required.

3.3 MULTI-LEVEL SWITCHING

- A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.

3.4 DIMMING

- A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:
 1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
 2. 2-Wire dimming – two line voltage conductors plus ground
 3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
 4. DALI – two low voltage conductors and two line voltage conductors plus ground
 5. Proprietary digitally addressable – as required per the manufacturer
 6. DMX – two line voltage conductors plus ground and DMX cabling
- B. Coordinate light fixture and control device dimming types for compatibility.

3.5 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of light fixtures and their mounting provisions on the pole. Install poles and other structural units level, plumb, and square.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 3. Trees: 15 feet.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space. Grout materials, installation, and finishing requirements are specified in Division 05 Section "Metal Fabrications".
 3. Install base covers, unless otherwise indicated.
 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Raise and set poles using web fabric slings (not chain or cable).

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems", including use of coated conduits in concrete foundations.

3.7 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole, unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting light fixture to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.
- C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.
- E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.
- F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.
- G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain light fixtures. Refer to Division 01 Section "Demonstration and Training."

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DIVISION 28 - FIRE ALARM SPECIFICATION

13980 (284600) FIRE DETECTION AND ALARM

END OF DIVISION 28

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SECTION 13980 (284600) FIRE DETECTION AND ALARM

NEW SPEC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
 - 2. Division 26 Section "Common Work Results for Electrical," for materials and methods for coordination, sleeves and common installation requirements.

1.2 DESCRIPTION OF WORK

- A. This Section requires the Contractor to furnish all materials required to install the fire alarm system. The Contractor shall be responsible for installing, testing, and start-up of a complete functioning fire alarm system, and each element thereof, as specified or indicated on the Drawings or reasonably inferred, including every article, device or accessory (whether or not specifically called for by item) necessary to facilitate each system's function as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation and utilities.
- B. Division 28 of the Specifications and Drawings numbered with prefixes FA generally describe these systems, but the scope of the Fire Alarm work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically and are intended to convey the scope of work, indicating the general location and arrangement of the major equipment, devices, appliances, etc. without showing all the exact details as to elevations, circuits, routing, and other installation requirements. Use the Drawings as a guide when laying out the system and verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. The scope of work in this section includes:
 - 1. Fire alarm control unit(s)
 - 2. Manual fire alarm pull stations
 - 3. System smoke detectors
 - 4. Aspirating smoke detection (ASD) systems
 - 5. Heat detectors
 - 6. Notification appliances
 - 7. Sprinkler system waterflow and valve tamper alarms
 - 8. Elevator recall
 - 9. Air handling unit shutdown
 - 10. Battery stand-by power
 - 11. Multi-channel one-way voice notification system
 - 12. Fire pump status monitoring
 - 13. Digital alarm communicator transmitter (DACT)

1.3 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Installation of devices shall be performed or supervised by a National Institute for Certification of Engineering Technologies (NICET) Level III or higher Fire Alarm Technician. Submit copies of the certification for employees through shop drawing submittals.

1.4 APPLICABLE CODES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities. Upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
 - 1. NFPA 70, "National Electrical Code", 2017 Edition.
 - 3. NFPA 72, "National Fire Alarm and Signaling Code", 2016 Edition.
 - 4. NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection", 2016 Edition.
 - 5. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
 - 6. FM Global, "Approval Guide", Latest Edition.
 - 7. California Building Code (CBC) 2019 Edition with local amendments.
 - 8. California Fire Code (CFC) 2019 Edition with local amendments.
- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

1.5 DEFINITIONS

- A. General:
 - 1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
 - 2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."
 4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
 5. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the AHJ over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 6. FACP: Fire Alarm Control Panel.
 7. NICET: National Institute for Certification in Engineering Technologies.
 8. ASD: Aspirating Smoke Detection.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

1.6 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.
- C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate their work with other contractors and subcontractors so that various components of the Fire Alarm systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.
- E. Where coordination and interfacing with other systems or equipment is required, it shall be the responsibility of the fire alarm system installer (contractor) to either provide the relays, contacts, power supplies and other necessary hardware or see to it that such hardware is provided with the other systems or equipment.
- F. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:
 1. Sprinkler waterflow and valve tamper switches shall be provided by the fire sprinkler installer, but wired and connected by the fire alarm installer.

2. Duct smoke detectors shall be furnished, wired and connected by the fire alarm system installer. The HVAC installer shall furnish necessary duct opening to install the duct smoke detector's housing.
 3. Air handling fan control circuits and contacts to be furnished by the HVAC control equipment.
 4. Conduit shall be by Division 26 "Common Work Results for Electrical".
- G. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.7 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.8 SUBMITTALS

- A. Refer to Division 1 and General Conditions for submittal requirements, in addition to requirements specified herein. Submittals not complying fully with the submittal requirements will be rejected.
- B. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval.
- C. Shop drawings shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations. Drawings that are not legible, or that do not contain sufficient detail to verify compliance with applicable codes and standards, will be rejected without further review.
- D. Submittals and shop drawings shall not contain HEI's firm name or logo, nor shall it contain the HEI's engineers' seal and signature. They shall not be copies of HEI's work product. If the contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.
- E. Submit Shop Drawings as early as required to support the project schedule. Allow for one week Engineer review time plus mailing time plus a duplication of this time for resubmittal if required. Submit Shop Drawings as soon as possible before construction starts.
- F. Before submitting Shop Drawings and material lists, the Contractor shall verify that the equipment submitted is mutually compatible and suitable for the intended use. Contractor shall verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- G. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the shop drawings have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials,

performance criteria and accessories being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

- H. The Engineer's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless the Contractor has, in writing, called the Engineer's and Architect's attention to such deviations at the time of submission, and secured written acceptance; nor shall it relieve the Contractor from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.
- I. Product Data: Provide a bill of materials and product cutsheets showing material specifications, electrical characteristics and connection requirements. Highlight or indicate specific product options and accessories as applicable to the project.
- J. Shop Drawings:
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Shop drawings shall be prepared by a NICET Level III or higher certified technician. Submit copies of the certification for the designer with submittal.
 - 3. The fire alarm system equipment vendor shall provide shop drawings showing fire alarm floor plans and a full building riser diagram. Fire alarm floor plans and riser diagram shall show fire alarm control panel, annunciator, all fire alarm initiating devices and notification appliances. Show typical wiring diagrams of control panel/s, annunciator and each device and wiring connections required. Show all interfaces to other systems, such as temperature control systems, and security systems.
 - 4. The fire alarm floor plans and riser diagram shall show wiring to all fire alarm devices/appliances, indicating wire sizes and quantities as well as conduit/raceway sizes and locations of end-of-line (EOL) resistors. The fire alarm floor plans and riser diagram shall clearly show the routing of all fire alarm system wiring, including all horizontal routing and vertical routing (in chases).
 - 5. Routing of all fire alarm wiring shall comply with the "Survivability" requirements of NFPA 72.
 - 6. Provide a Sequence of Operations Matrix that explains how the submitted fire alarm system functions.
 - 7. Include voltage drop calculations for notification-appliance circuits.
 - 8. Include battery-size calculations.
 - 9. Shop drawing scale shall match the Engineer's drawings where possible.
 - 10. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
- K. Indicate within the submittal all applicable UL listings and all applicable approvals or certifications.
- L. Qualification Data: Submit copies of the certification for the Installer.
- M. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall complete and send the form attached at the end of this section along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.10 SUBSTITUTIONS

- A. Refer to Division 1 and General Conditions for Substitutions.
- B. Materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten calendar days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Engineer's decision of approval or disapproval to bid of a proposed substitution shall be final.
- D. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
- E. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.11 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1 and General Conditions for Operational and Maintenance Manuals.
- B. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- C. The O&M Manuals shall be provided in labeled 3-ring binder with cover, binding label, tabbed fly sheets and plastic insert folders for Record Drawings. Include the following sections with the appropriate information for each section:
 - 1. Typewritten Index.
 - 2. Qualifications. Provide designer and installer qualification.
 - 3. Bill of Materials. Provide complete nomenclature, model number and vendor information for all parts.
 - 4. Operating Instructions. Complete instructions detailing operation and maintenance of all equipment installed.
 - 5. Product Data: Provide product cutsheets for all equipment utilized and installed.
 - 6. Riser diagram.
 - 7. Device addresses.
 - 8. Record copy of site-specific software.
 - 9. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - a. Equipment tested.
 - b. Frequency of testing of installed components.
 - c. Frequency of inspection of installed components.
 - d. Requirements and recommendations related to results of maintenance.
 - e. Manufacturer's user training manuals.
 - 10. Manufacturer's required maintenance related to system warranty requirements.
 - 11. Abbreviated operating instructions for mounting at fire alarm control unit and each annunciator unit.
 - 12. Guarantee. Copy of all guarantees and warranties issued.
 - 13. Contact list with minimum three service representative phone numbers.

1.12 RECORD DRAWINGS

- A. A set of prints shall be kept on the jobsite during construction for the purpose of noting changes to location of all fire alarm equipment, devices, appliances and circuits as finally installed. During the course of construction, the Contractor shall indicate on these drawings, changes made from the Contract Drawings. Particular attention shall be made to those items which need to be located for servicing.
- B. The record drawings shall show actual locations of initiating devices, notification appliances, and end-of-line devices. Show the approximate location, size and type of all wiring and routing of wiring. Drawings should also include one-line riser diagrams showing all devices.
- C. The Contractor shall sign-off on the Record Drawings as being an accurate representation of the completed installation.
- D. Refer to Division 1 and General Conditions for Record Drawings
- E. At the completion of the project, the Contractor shall obtain at their expense, reproducible copies of the drawings and incorporate changes noted on the jobsite work prints onto these sheets. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", with date. The drawings and associated system calculations shall be delivered to the Architect.

1.13 SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide 10% of the total or a minimum of one (1) manual pull station.
 - 2. Provide 10% of the total or a minimum of two (2) of each type of automatic smoke detector.
 - 3. Provide 5% of the total or a minimum of one (1) of each type of automatic heat detector.
 - 4. Provide 5% of the total or a minimum of one (1) of each type of ASD detector.
 - 5. Provide 5% of the total or a minimum of two (2) of each strobe type and candela rating.
 - 6. Provide 5% of the total or a minimum of two (2) of each horn/speaker type. Combination horn/speaker/strobe units matching the units installed are acceptable.
 - 7. Keys and Tools: One extra set for access to locked or tamper proofed components.

1.14 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products indicated in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed Contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire alarm submittal proof of factory training for each installer.
- C. Final checkout and verification: Shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET) registered as level III or higher in the fire protection technology certification program. Provide certification information with fire alarm submittal.
- D. The equipment manufacturer's service department shall be fully stocked in standard parts and components and engaged in the maintenance of fire alarm systems. On-the-premises service shall be available within 4 hours of notification, 7 days a week, 24 hours a day.

1.15 GUARANTEES AND WARRANTIES

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties.

- B. Furnish service and maintenance of fire alarm system including wiring and raceways for one year from date of substantial completion.
- C. All components, system software, parts and assemblies shall be guaranteed against defects in materials and workmanship for the one-year period stated above, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty.
- D. Labor (including travel expenses) to trouble-shoot, repair, reprogram, or replace components shall be furnished by this contractor at no charge during the warranty period.
- E. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software.

1.16 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:
 1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting a bid to determine the nature and extent of work involved.
 2. Work in the existing building shall be scheduled with the Owner.
 3. Certain demolition work must be performed prior to the remodeling. The Fire Alarm Contractor shall perform the demolition which involves fire alarm system equipment and materials.
 4. Fire Alarm Contractor shall remove articles which are not required for the new work. Unless otherwise indicated, each item removed by the Contractor during this demolition shall be removed from the premises and disposed of in accordance with applicable federal, state and local regulations.
 5. Fire Alarm Contractor shall relocate and reconnect fire alarm equipment that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. General Contractor shall install finish material.
 6. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
 7. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 8. Locate, identify, and protect Fire alarm services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

PART 2 - PRODUCTS AND MATERIALS

2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-listed, networked addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- B. All components provided shall be listed for use with the selected system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Source Limitations for Fire alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested, and will operate, as a system.

2.2 MANUFACTURER

- A. Subject to compliance with requirements, provide products manufactured by the following manufacturer as indicated on the Drawings:
 - 1. Edwards

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual pull stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Aspirating smoke detection system.
 - 5. Automatic sprinkler system water flow.
- B. Fire alarm signal shall initiate the following actions:
 - 1. Identify alarm and specific initiating device at fire alarm control unit(s) and remote annunciators (if provided).
 - a. A pulsing alarm tone shall occur within the control panel until acknowledged.
 - b. The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.
 - 2. Transmit an alarm signal to the alarm supervising station.
 - 3. The audible and visible alarm signal shall operate until it is manually silenced or acknowledged.
 - 4. Record events in the system memory.
 - 5. Unlock electric door locks in designated egress paths.
 - 6. Release fire and smoke doors held open by magnetic door holders.
 - 7. Activate voice/alarm communication system.
 - 8. All fan-powered air-handling equipment shall shutdown and remain down until the fire alarm control panel is reset.
 - 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 10. Shutdown audio system/background music.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Duct-smoke detectors
 - 3. High- or low-air-pressure switch of a dry-pipe or pre-action sprinkler system.
 - 4. Alert and Action signals of aspirating detection system.
 - 5. Fire pump running.
 - 6. Fire pump loss of power.
 - 7. Fire pump power phase reversal.
 - 8. Independent fire detection and suppression systems.
 - 9. User disabling of zones or individual devices.
 - 10. Loss of communication with any panel on the network.
- D. System Supervisory Signal Actions:

1. Identify specific device causing supervisory signal fire alarm control unit and remote annunciators (if provided).
 - a. Visible and audible supervisory alarm indicated by address at fire alarm control panel.
 - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible supervisory alarm; visible alarm is displayed until device is returned to its normal position/supervisory condition is cleared.
2. Record events in the system memory.
3. After a time delay of 90 seconds transmit a supervisory signal to the alarm supervising station.
4. Duct-mounted smoke detectors shall shutdown their respective unit upon detection of smoke and remain down until manually reset.
5. Individual fan-powered air distribution equipment less than 2,000 cfm that is not provided with duct detection shall shutdown when the respective air handling unit is shutdown.

E. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire alarm control unit.
5. Ground or a single break in internal circuits of fire alarm control unit.
6. Abnormal ac voltage at fire alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire alarm control unit or annunciator.
10. Voice signal amplifier failure.

F. System Trouble Signal Actions:

1. Identify specific device causing trouble signal fire alarm control unit and remote annunciators (if provided).
 - a. Visible and audible trouble alarm indicated by address at fire alarm control panel.
 - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible trouble alarm; visible alarm is displayed until device is returned to its normal position/trouble condition is cleared.
2. Record events in the system memory.
3. After a time delay of 90 seconds, transmit a trouble signal to the alarm supervising station.
4. Transmit system status to building management system.
5. Display system status on graphic annunciator.

2.4 FIRE ALARM SYSTEM CONTROL PANEL

A. General Requirements for Fire Alarm Control Panel:

1. Edwards EST4 addressable multi-zone fire alarm system
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Provide fiber connection between the FACP and FACU/Transponder panels.
 - c. The FACP shall be listed for connection to a central-station signaling system service.
 - d. The FACP shall be provided with surge protection.
 - e. Install in a flush mounted enclosure.
 - f. The fire alarm system control unit shall be UL listed for releasing service.
 - g. Additional FACP/FACU components detailed in drawings, contractor to provide all necessary components for intended function.

- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

- C. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. The location of the dedicated branch circuit disconnecting means shall be permanently identified at the control unit.
 - 2. The circuit disconnecting means shall have a red marking and be provided with a breaker lock or other approved method to avoid accidental operation.
 - 3. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

- D. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead acid.
 - 2. The secondary power system shall operate system in standby mode for 4 hours followed by alarm mode for 15 minutes.

- E. System Supervision: Automatically detects and reports open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits. Alarm, supervisory and trouble signals shall be monitored by the supervising station over a Digital Alarm Communicator Transmitter (DACT), or other approved method.

- F. Fire Pump Control and Status: Provide supervised START (no STOP control shall be installed) controls and visible alarm status indication at the Fire Command Center and at the Remote Annunciator for the fire pump in accordance with NFPA 20. Coordinate with the fire pump controller supplier and provide the necessary conduit and wiring for the control and status indication. Refer to Division 21.

- G. Elevator Recall and Shutdown: Provide output signals to the elevator controller(s) using addressable relays to initiate elevator recall and shutdown functions per ASME A17.1. Provide equipment, output signals and logic as required by code and by the elevator system supplier and installer.
 - 1. Elevator recall shall be initiated by any one of the following alarm-initiating devices:
 - a. Elevator lobby detector(s).
 - b. Smoke detector in elevator machine room.
 - c. Smoke detector(s) in elevator hoistway.
 - d. Heat detector(s) in elevator pit.
 - 2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
 - 3. Elevator shutdown shall be initiated by any one of the following alarm-initiating devices:
 - a. Heat detector in elevator machine room.
 - b. Heat detector(s) at top of elevator hoistway.

2.5 EMERGENCY VOICE/ALARM COMMUNICATIONS SYSTEMS (EVACS):

- A. The system shall incorporate one-way emergency voice communication via specified speakers. A central audible module shall provide for the necessary alarm message/tone generation, main and remote microphone connections and mixers/pre-amplifier circuits. Continuous supervision shall be provided along with specific information as to the type of failure (main microphone trouble, tone trouble, etc.)

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire alarm control unit.
2. Hand held push to talk, noise canceling microphone in recessed protective panel mounted enclosure; 5 feet coiled cable; and LED to indicate the microphone push to talk has been pressed.
3. Audible power amplifiers shall be self filtered; contain 24 volt power supply, transformer and amplifier monitor circuits; Amplifier shall operate all system speakers plus twenty-five (25) percent spare capacity.
4. Digitized voice messages are required to notify building occupants during alarm conditions. Message player shall not rely on tape or mechanical means of transmitting the voice message. A standard evacuation message shall be provided; however, the system shall be capable of transmitting a custom message of up to five (5) minutes long.
5. Alarm sequence shall consist of a temporal (3) alarm tone for a maximum of 15 seconds followed by an automatic pre-selected message. At the end of the message the tone shall resume. This sequence shall continue until the fire alarm control panel has been silenced. Manual voice paging shall be available via panel switches to page individual floors or groups of floors. Each floor shall be an individual audible zone and have a corresponding audible switch.

2.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter (DACT) shall be acceptable to the central station and shall comply with UL 864.
- B. The installing contractor shall select the appropriate DACT equipment based on the available communication methods.
- C. Coordinate with General Contractor to ensure proper connections are provided for communication to and from the DACT. Two (2) separate communication methods are required and shall not be subject to a common failure within the scope of work identified within these contract documents. Unless noted otherwise, the installing contractor shall utilize two (2) of the following communication methods:
 1. Building 10/100 Base network (LAN), DSL modem, or cable modem.
 2. Bosch 465 Cellular Communicator.
 - a. The transmitter shall automatically detect and choose the best network in the area based on signal strength and immediately self-adjust for operation as necessary.
 3. Other alternative method complying with the performance requirements of NFPA 72 for 'Communication Methods for Supervising Station Alarm Systems that is acceptable to the Authority Having Jurisdiction and the Engineer of Record. Approval of any alternative methods must be obtained from the Engineer of Record via an RFI prior to submitting bids for the scope of work.
- D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire alarm control unit and automatically transmit across the primary communication method. If service on the primary communication method is interrupted for longer than 45 seconds, the transmitter shall initiate a local trouble signal and transmit a signal indicating loss of primary communication to the supervising station over the secondary communication method. Transmitter shall automatically report communication restoration to the supervising station. If service is lost on both communication methods, transmitter shall initiate a local trouble signal.
- E. Digital data transmission shall include the following:

1. Address of the alarm initiating device.
2. Address of the supervisory signal.
3. Address of the trouble signal.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to supervising station.

2.7 FIRE ALARM SYSTEM CONTROL UNIT(S)/TRANSPONDERS

A. Description: Alphanumeric display and LED indicating lights shall match those of fire alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

1. Mounting: Flush
2. Provide remote microphone and emergency/voice alarm system controls.
3. Additional details/components provided in drawing set.

2.8 INITIATING DEVICES

A. Manual Fire Alarm Boxes: Edwards Addressable Signature Series SIGA-278

1. Double action mechanism requiring two actions to initiate an alarm, pull lever type; with integral addressable module arranged to communicate manual station status (normal, alarm, or trouble) to fire alarm control unit.
2. Station Reset: Key or wrench operated switch.
3. Indoor Protective Shield: Factory fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

B. System Smoke Detectors: Edwards Addressable Signature Series SIGA-OSD w/ SIGA-SB4 base.

1. Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
2. Device shall have an integral visual-indicating light, LED type, indicating detector has operated and power-on status.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Photoelectric detectors shall have sensitivity between 0.5 and 3.5 percent/foot smoke obscuration.

C. Duct Smoke Detectors: Edwards Addressable Signature Series SIGA-SD

1. Provide for variations in duct air velocity between 100 and 4,000 feet per minute.
2. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet.
3. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
4. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor control circuit.
5. Provide remote alarm LEDs and remote test stations as shown on the plans.
6. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.

- D. Heat Detectors: Edwards Addressable Signature Series SIGA-HRD w/ SIGA-SB4 base.
 - 1. Detector shall have twist lock base interchangeable with smoke detectors bases and be equipped with an integral addressable module arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
 - 2. Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 3. Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 135 deg F (88 deg C).

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 1. Combination Devices: Factory integrated audible and visible devices in a single mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections. Minimum audible level and strobe intensity shall meet all requirements for separate appliances.
 - 2. Provide strobe synchronization as required per NFPA 72.
 - 3. Wall mounted notification appliances shall be manufacturer standard red finish unless noted otherwise on drawings.
 - 4. Ceiling mounted notification appliances shall be manufacturer standard white finish unless noted otherwise on drawings.
- B. Exterior Alarm Bells: Electric vibrating, 10-inch bell with operating mechanism behind dome and weatherproof bell kit. Sound Rating: 90 dB at 10 feet.
- C. Alarm Horns: Comply with UL 464. Electric vibrating polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Alarm Speakers: Comply with UL 1480. High quality tone and voice reproduction; capacitor connected for connection to supervised notification appliance circuit; semi-flush mounting; four inch cone; high impact, flame retardant PC/ABS thermoplastic; 25 or 70 VRMS; multi-tapped output power rated ¼ to 2 watts and produce 79 to 88 dB at 10 feet.
- E. Special Application Speakers (Warehouse):
 - 1. Edwards TCPA-10 70v loudspeakers
- F. Visible Alarm Notification Appliances (Strobes): Xenon strobe lights complying with UL 1971, unfiltered or clear filtered white light, with candela ratings as indicated on drawings. Strobes shall meet all requirements of the Americans with Disabilities Act.

2.10 AUXILIARY DEVICES

- A. Waterflow Alarm Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer. Switch shall have an adjustable delay to minimize false alarms due to fluctuations in water pressure.
- B. Valve (Tamper) Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer.
- C. Monitor Module: Addressable microelectronic module providing a system address for alarm initiating devices for wired applications with normally open contacts. Include address setting means on the module.
- D. Control/Relay Module: Provide intelligent control relay modules. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment

shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

- E. Fire Department Key Box: Shall be by Knox Company or as otherwise specified by the authority having jurisdiction. Provide internal switch(es), as required by the Authority Having Jurisdiction, to indicate supervisory condition(s) at the fire alarm control and annunciator panels.

2.11 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for smoke detectors, notification appliances, or other device requiring protection as indicated on the plans.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Factory finished to match the color of the protected appliance or device.

2.12 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Building wire as specified in Division 26.
- B. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.
- C. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.
- D. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.
- E. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.
- F. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.
- G. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- H. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket and red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated.
- I. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the class of the circuitry selected.
 - 1. Initiating Device Circuits: Class B.
 - a. Pathway Survivability: Level 1.
 - 2. Notification Appliance Circuits: Class B.
 - b. Pathway Survivability: Level 1.
 - 3. Signaling Line Circuits: Class B.
 - c. Pathway Survivability: Level 1.

4. Any circuits interconnecting fire alarm control panels between separate buildings shall be provided with surge protection.

2.13 ACCESS TO EQUIPMENT

- A. All detectors, modules, equipment, etc. shall be located so as to provide easy access for operation, service inspection and maintenance.
- B. Access Doors:
 1. Provide access doors for all concealed equipment, except where above lay-in ceilings.
 2. Access doors shall be adequately sized for the devices served with a minimum size of 18" x 18", furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
 3. Access doors must be of the proper materials for type of construction where installed.
 4. The exact location of all access doors shall be verified with the Architect prior to installation.
 5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
 6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - b. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
 8. Locking Devices: Flush, screwdriver-operated cam locks.
 9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Arrow United Industries.
 - b. Bar-Co., Inc.
 - c. J.L Industries.
 - d. Karp Associates, Inc.
 - e. Milcor Div. Inryco, Inc.
 - f. Nystrom Building Products
 - g. Wade
 - h. Zurn

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install, program and test all new equipment identified in this contract in accordance with the applicable codes, standards, and manufacturer's instructions.
- B. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.
- C. The Contractor shall provide all required conduit and all associated hardware, and shall install (pull), connect, and test all cable for a complete fire alarm system. All wiring shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel.
 - 2. Expand, modify, and supplement existing control/monitoring equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- D. Manual Fire alarm Boxes: Provide manual fire alarm boxes as shown on drawings. Mount manual fire alarm box on a background of a contrasting color. The operable part of manual fire alarm box shall be at 48 inches above floor level unless noted otherwise.
- E. Smoke and Heat Detectors: Provide detectors as shown on drawings.
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat detector spacing.
 - 3. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 - 4. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
 - 5. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
 - 6. Install ceiling mounted detectors in areas with exposed structure tight to underside of floor/roof deck unless noted otherwise on drawings.
- F. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct. Tubes more than 36 inches long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke detector housing during construction. Install detector only during system testing and prior to system turnover.
 - 2. Provide duct detection and shutdown for fan powered air distribution equipment exceeding 2,000 cfm.

3. Provide equipment and connections to shutdown fan powered air distribution equipment with a capacity less than 2,000 cfm that are part of an air distribution system with a capacity greater than 2,000 cfm.
- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in unsprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, or valve-tamper switch that is not readily visible from normal viewing position.
- I. Install ceiling mounted visible and audible/visible notification appliances in areas with exposed structure to bottom of floor/roof structure or at 30 ft AFF, whichever is lower unless noted otherwise on drawings.
- J. Install ceiling mounted visible and audible/visible notification appliances in areas with finished ceilings flush with bottom of ceiling or at 30 ft AFF, whichever is lower unless noted otherwise on drawings.
- K. Install wall mounted visible and audible/visible notification appliances with visible element (strobe) between 80 inches and 96 inches above finished floor unless noted otherwise on drawings.
- L. All notification appliance speakers shall be tapped at ½ watt unless noted otherwise on drawings. In rooms less than 100 sq ft, speakers are permitted to be tapped at ¼ watt.

3.4 PATHWAYS

- A. Pathways above suspended ceilings and in nonaccessible locations may be routed exposed where permitted by NFPA 70 & 72.
 1. Exposed pathways located less than 96 inches above the floor shall be installed in conduit.
- B. Pathways shall be installed in conduit.
- C. All detection and control circuits associated with smoke control systems shall be fully enclosed within continuous raceways.
- D. Minimum allowable conduit size shall be ¾ inch. The conduit shall be sized so that conduit fill does not exceed 75% of NFPA 70 maximum fill requirements. Cables in vertical risers shall not exceed 50% of NFPA 70 maximum fill requirements. Conduit installation shall be as required by the Contractor's layout and as described in these specifications. All conduit field routing shall be acceptable to the Owner. Routing not acceptable shall be rerouted and replaced without expense to the Owner.
- E. All wire, cable, conduit and raceways shall be concealed in walls, ceiling spaces, electrical shafts or closets in finished areas except as specifically noted otherwise. Conduit and raceways may be exposed in unfinished areas or where specifically approved by the Owner.
- F. Except as otherwise specified or indicated on the drawings, all conduit shall be installed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.
- G. Conduit shall be located at least six inches from hot water or steam pipes, and from other hot surfaces. Conduit shall not block access to any existing equipment or fixtures.
- H. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit for conventional hardwired class B initiating and notification appliance circuits.

- I. Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit. The locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box. Conduit shall enter cabinets from the bottom and sides only.

3.5 CONNECTIONS

- A. All wiring shall be terminated at devices or panels using terminal connectors for screw type terminals. All terminal connectors for conductors shall be pre-insulated ring type or pre-insulated spade type. Pre-insulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size. Pre-insulated terminal connectors shall include a metallic support sleeve bonded to the vinyl-insulating sleeve and designed to grip the conductor insulation.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm initiating connection to smoke control system (smoke management) at firefighters' smoke control system panel.
 - 2. Alarm initiating connection to stairwell and/or elevator shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated HVAC systems.
 - 4. Provide equipment and connections to shutdown fan powered air distribution equipment with an individual capacity less than or equal to 2,000 cfm that are part of an air distribution system with a design capacity greater than 2,000 cfm.
 - 5. Electronically locked doors and access gates.
 - 6. Alarm initiating connection to elevator recall system and components.
 - 7. Alarm initiating connection to activate emergency lighting control.
 - 8. Connection to disable sound systems upon alarm activation.
 - 9. Supervisory connections at valve supervisory switches.
 - 10. Supervisory connections at low-air pressure switch of each dry-pipe sprinkler system.
 - 11. Supervisory connections at elevator shunt-trip breaker.
 - 12. Data communication circuits for connection to building management system.
 - 13. Supervisory connections at fire pump power failure including a dead-phase or phase-reversal condition.
 - 14. Supervisory connections at fire pump engine control panel.
 - 15. ASD Components. Including but not limited to; command, display and detector modules.

3.6 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. All conduits and junction boxes shall be labeled as specified in Division 26 (red).
- C. The location of end-of-line resistors shall be identified with a label indicating "EOL."
- D. Provide label at each initiating device indicating the device address. Label shall be visible from the floor below or immediately adjacent to the device.

3.8 GROUNDING

- A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

- A. Systems shall be checked and tested in accordance with the instructions provided by the manufacturer to insure that the system functions as required and is free of grounds, opens, and shorts. Each device shall be tested.
 - 1. Smoke detectors shall be tested with products of combustion.
- B. Upon completion of the system installation and before the Date of Final Acceptance, a factory-trained technician shall perform all necessary tests and adjustments and shall then file a Letter of Certification and a Certificate of Completion (NFPA 72) with the Owner indicating that the system functions and conforms to the Fire Alarm System Specifications.
- C. Upon completion of the system installation, a factory-trained technician shall perform all necessary tests and adjustments in the presence of the Owner's designated personnel. Test in accordance with NFPA 72 and requirements of the authority having jurisdiction. Perform the following tests at a minimum:
 - 1. Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - a. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - b. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire alarm system will be considered defective if it does not pass tests and inspections.
- F. Include services of factory trained and certified technician to supervise installation, adjustments, final connections, and system testing as performed by the fire alarm contractor's factory-trained technicians.

3.10 DEMONSTRATION

- A. The equipment supplier's factory trained technician shall train the Owner's personnel in the proper use and maintenance of the system. Training sessions shall be conducted as needed, for a total of up to eight (8) hours.
- B. Demonstrate normal and abnormal modes of operation, and required responses to each.
- C. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

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SPECIFICATION FOR RAMMED AGGREGATE PIER® FOUNDATION SYSTEMS

PART 1: GENERAL REQUIREMENTS

1.01 Description

Work shall consist of designing, furnishing and installing Rammed Aggregate Pier foundations to the lines and grades designated on the project foundation plan and as specified herein. The aggregate piers shall be constructed by either augering a cavity or driving a hollow mandrel to the design depth and vertically ramming lifts of aggregate using the specially designed tamper head and high-energy impact densification equipment to create the compacted aggregate pier. The Rammed Aggregate Pier elements shall be in a columnar-type configuration and shall be used to produce an intermediate foundation system for support of foundation loads.

1.02 Work Included

- A. Provision of all equipment, material, labor, and supervision to design and install Rammed Aggregate Pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of Rammed Aggregate Pier elements, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.
- B. The Rammed Aggregate Pier design and installation shall adhere to all methods and standards described in this Specification.
- C. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.03 Approved Installers

- A. The Rammed Aggregate Pier Installer (the Installer) shall be approved by the Owner's Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner's Engineer at least two (2) weeks prior to bid opening.
- B. Installers of Rammed Aggregate Pier foundation systems shall have a minimum of 5 years of experience with the installation of Rammed Aggregate Pier systems and shall have completed at least 50 projects.
- C. Installers licensed by the Geopier Foundation Company, Inc. (www.geopier.com) will be accepted as approved installer.
- D. Without exception, no alternate installer will be accepted unless approved by Owner's Engineer and Geopier Foundation Company, Inc.
- E. Installers currently approved for these works are:

Western Ground Improvement, Irvine, CA
Foundation Service Corp., Hudson, IA
GeoConstructors, Inc., Leesburg, VA
Geopier-Northwest, Inc., Bellevue, WA
Helical Drilling, Inc. Braintree, MA
Peterson Contractors, Inc., Reinbeck, IA
Amcon Limited, Nova Scotia, Canada
GeoSolv Design/Build, Inc., Ontario, Canada
Rapid Impact Piers, Ltd., British Columbia, Canada

1.04 Reference Standards

- A. Design
 - 1. “Control of Settlement and Uplift of Structures Using Short Aggregate Piers,” by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.*
 - 2. “Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers,” by Evert C. Lawton and Nathaniel S. Fox. *Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments*, ASCE, 2, 962-974.
 - 3. “Behavior of Geopier®-Supported Foundation Systems during Seismic Events,” by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.
- B. Modulus Testing
 - 1. ASTM D 1143 - Pile Load Test Procedures
 - 2. ASTM D 1194 - Spread Footing Load Test
- C. Materials and Inspection
 - 1. ASTM D 1241 - Aggregate Quality
 - 2. ASTM D 422 - Gradation of Soils
- D. Where specifications and reference documents conflict, the Rammed Aggregate Pier Designer shall make the final determination of the applicable document.

1.05 Certifications and Submittals

- A. Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Rammed Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner’s Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.
- B. Professional Liability Insurance - The Rammed Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of \$3 million per occurrence.
- C. Modulus Test Reports – A modulus test(s) is performed on a non-production Rammed Aggregate Pier element as required by the Rammed Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer.
- D. Daily Rammed Aggregate Pier Progress Reports – The Installer shall furnish a complete and accurate record of Rammed Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification

forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

PART 2: MATERIALS

2.01 Aggregate

- A. Aggregate used by the Rammed Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.
- B. Potable water or other suitable source shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

PART 3: DESIGN REQUIREMENTS

3.01 Rammed Aggregate Pier Design

- A. The design of the Rammed Aggregate Pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Rammed Aggregate Pier system. The Rammed Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50 years.
- B. The design shall meet the following criteria.

Maximum Allowable Bearing Pressure for Footings supported by Rammed Aggregate Pier Reinforced Soils	Up to 10,000 psf
Estimated Total Long-Term Settlement for Footings:	≤ 1-inch
Estimated Long-Term Differential Settlement of Adjacent Footings:	≤ ½-inch
- C. The Rammed Aggregate Pier elements shall be designed using a Rammed Aggregate Pier stiffness modulus to be verified by the results of the modulus test described in Section 5.02 of these specifications.

3.02 Design Submittal

The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least 3 week(s) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State or Province where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 4: EXECUTION

4.01 Approved Installation Procedures

The following sections provide general criteria for the construction of the Rammed Aggregate Pier elements. Unless otherwise approved by the Designer, the installation method used for Rammed Aggregate Pier construction shall be that as used in the construction of the successful modulus test.

- A. Augered Rammed Aggregate Pier systems –
 - 1. Augered Rammed Aggregate Pier system shall be pre-augered using mechanical drilling or excavation equipment.
 - 2. If cave-ins exceeding 10% of the lift volume occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity or a displacement Rammed Aggregate Pier system may be used.
 - 3. Aggregate shall be placed in the augered cavity in lift thicknesses as determined by the Rammed Aggregate Pier Designer.
 - 4. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The apparatus shall apply direct **downward** impact energy to each lift of aggregate. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.

- B. Displacement Rammed Aggregate Pier systems –
 - 1. Displacement Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15 ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Rammed Aggregate Pier designer.
 - 2. Special high-energy impact densification apparatus shall be employed to vertically densify the Rammed Aggregate Pier elements during installation of each constructed lift of aggregate.
 - 3. Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.
 - 4. Downward crowd pressure shall be applied to the mandrel during installation.

4.02 Plan Location and Elevation of Rammed Aggregate Pier Elements

The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

4.03 Rejected Rammed Aggregate Pier Elements

Rammed Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

PART 5: QUALITY CONTROL

5.01 Control Technician

The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Rammed Aggregate Pier Designer, the General Contractor, and to the Testing Agency.

5.02 Rammed Aggregate Pier Modulus Test

As required by the RAP designer, a Rammed Aggregate Pier Modulus Test(s) will be performed at locations agreed upon by the Rammed Aggregate Pier Designer and the Testing Agency to verify or modify Rammed Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Rammed Aggregate Pier design submittal.

5.03 Bottom Stabilization Testing (BSTs) / Crowd Stabilization Testing (CSTs)

Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. Additional testing as required by the Rammed Aggregate Pier Designer shall be performed on selected production Rammed Aggregate Pier elements to compare results with the modulus test pier.

PART 6: QUALITY ASSURANCE

6.01 Independent Engineering Testing Agency (Owner's Quality Assurance)

The Rammed Aggregate Pier Installer shall provide full-time Quality Control monitoring of Rammed Aggregate Pier construction activities. The Owner or General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

6.02 Responsibilities of Independent Engineering Testing Agency

- A. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.
- B. The Testing Agency shall monitor the installation of Rammed Aggregate Pier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.
- C. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.
- D. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

PART 7: RESPONSIBILITIES OF THE GENERAL CONTRACTOR

7.01 Site Preparation and Protection

- A. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Rammed Aggregate Pier elements.
- B. Site grades for Rammed Aggregate Pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize Rammed Aggregate Pier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Rammed Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.
- C. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Rammed Aggregate Pier installation.
- D. Prior to, during and following Rammed Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.
- E. If spoils are generated by Rammed Aggregate Pier installation, spoil removal from the Rammed Aggregate Pier work area in a timely manner to prevent interruption of Rammed Aggregate Pier installation is required.

7.02 Rammed Aggregate Pier Layout

The location of Rammed Aggregate Pier-supported foundations for this project, including layout of individual Rammed Aggregate Pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

7.03 Contractor's / Owner's Independent Testing Agency (Owner's Quality Assurance)

General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 6 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 5 of this specification.

7.04 Excavations of Obstructions

- A. Should any obstruction be encountered during Rammed Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location.
- B. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

7.05 Utility Excavations

The General Contractor shall coordinate all excavations made subsequent to Rammed Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Rammed Aggregate Pier construction drawings. Protection of completed Rammed Aggregate Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Rammed Aggregate Pier elements, the General Contractor shall contact the Rammed Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

7.06 Footing Bottoms

- A. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.

- B. Foundation excavations to expose the tops of Rammed Aggregate Pier elements shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Rammed Aggregate Pier elements before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Rammed Aggregate Pier elements and the concrete footing.
- C. All excavations for footing bottoms supported by Rammed Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:
 - 1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).
 - 2. Compaction of surface soil and top of Rammed Aggregate Pier elements shall be prepared using a motorized impact compactor (“Wacker Packer,” “Jumping Jack,” or similar). Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.
 - 3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.
- D. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:
 - 1. That water (which may soften the unconfined matrix soil between and around the Rammed Aggregate Pier elements, and may have detrimental effects on the supporting capability of the Rammed Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.
 - 2. That all Rammed Aggregate Pier elements designed for each footing have been exposed in the footing excavation.
 - 3. That immediately before footing construction, the tops of Rammed Aggregate Pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.
 - 4. That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Rammed Aggregate Pier construction drawings, without the written approval of the Installer or Designer.
- E. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Rammed Aggregate Pier Installer, may void any written or implied warranty on the performance of the Rammed Aggregate Pier system.

PART 8: PAYMENT

8.01 Method of Measurement

- A. Measurement of the aggregate piers is on a lump sum basis.
- B. Payment shall cover design, supply and installation of the aggregate pier foundation system. Excavation of unsuitable materials, delays, re-engineering, and remobilization as documented and approved by the Owner or Owner’s Engineer, shall be paid for under separate pay items.

8.02 Basis of Payment

- A. The accepted quantities of piers will be paid per approval, in-place aggregate-pier. Payment will be made under:

<u>Pay Item:</u>	<u>Pay Unit:</u>
Preparation of plans and specifications and installation of rammed aggregate pier elements	\$____ Lump Sum

- B. Unit prices shall be provided to account for:

Additional Installed Piers (w/o remobilization)	\$____ Each
Add for Casing Holes	\$____/Linear Foot
Additional Mobilizations	\$____ Each
Additional Modulus or Uplift Load Tests	\$____ Each

SECTION 02300 (31 2000) – EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, filling, and backfilling for structures, pavement, and outparcels.
2. Trenching and backfilling for utilities.
3. Dewatering.
4. Boring under crossings.

B. Related Requirements:

1. Section 02318 - Rock Excavation.
2. Section 02340 - Soil Stabilization.
3. Section 02370 - Erosion Control and Sedimentation. Temporary and permanent erosion control.
4. Section 02375 - Stone Protection. Rip-rap stone for slope protection.
5. Section 02900 - Planting
6. Division 3 - Subbase requirements for granular subbase below building slabs.
7. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. ASTM International (ASTM)

1. ASTM C136 - Particle Size Analysis of Soil.
2. ASTM D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³)).
3. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedures).
5. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
6. ASTM D4829 – Standard Test Method for Expansion of Soils.
7. ASTM D5778 – Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils.
8. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

C. State of California Department of Transportation (CALTRANS):

1. 2018 Standard Specifications

D. City of Stockton

1. City of Stockton Standard Specifications, latest edition

E. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code.

F. American Water Works Association (AWWA)

1. AWWA C200 - Standard for Steel Water Pipe - 6 In. (150 mm) and Larger.
2. AWWA C206 - Field Welding Of Steel Water Pipe.

1.3 DEFINITIONS

- A. Satisfactory Materials: ASTM D2487 soil classification groups GW, GP, GM, SW, SP, SM, ML, CL, [CH,] [MH,] [SC,][GC,] or a combination of these group symbols.
 - 1. Fill material shall further conform to the plasticity index and liquid limits (PI and LL) specified in Paragraph FILLING hereinafter.
 - 2. Satisfactory materials shall be free of rock or gravel larger than allowed for fill or backfill material as specified hereinafter or as shown on the drawings.
 - 3. Satisfactory materials shall contain no debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 4. Unless specifically stated otherwise in "Foundation Subsurface Preparation" on the Drawings, the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of satisfactory materials to be used as fill in specified areas:

<u>Location</u>	<u>PI</u>	<u>LL</u>
Building area (below upper four feet)	10	30
Building area (upper four feet)	10	30
Areas outside the building pad including outparcels	10	30

- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory.
 - 1. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory materials which contains root and other organic matter or frozen material. The CTL shall be notified of any contaminated materials.
 - 2. Unsatisfactory materials also include satisfactory materials not maintained within optimum and 3 percent above optimum moisture content at time of compaction.
- C. Rock: Rock shall be as defined in Section 02318.

1.4 SUBMITTALS

- A. Submit 30-pound sample of each type of off-site fill material that is to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.
- B. Submit name of each material supplier and specific type and source of each material. Change in source throughout project requires approval of Owner.
- C. Submit Dewatering Plans upon request by Owner.
- D. Shop drawings or details pertaining to excavating and filling are not required unless otherwise shown on the Drawings or if contrary procedures to Construction Documents are proposed.
- E. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to The Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.
- F. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

PART 2 - PRODUCTS

2.1 SOIL AND ROCK MATERIALS

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- A. Fill and Backfill. Satisfactory materials excavated from the site. The following supersedes Caltrans Section 19-3.03I in total: CDF will be accepted in lieu of the standard backfill specifications. It shall be mandatory in all situations where the prevention of subsequent settlement after placement of backfill is required and in trenches eight (8) inches wide or less.
- B. Imported Fill Material: Satisfactory material provided from offsite borrow areas when sufficient satisfactory materials are not available from required excavations.
- C. Trench Backfill: ASTM D2321 unless otherwise specified or shown on the drawings.
- D. Building Subbase Material: Subbase for building and appurtenances slabs on ground is specified in Section 03300 or 03312 as applicable.
- E. Bedding: Aggregate Type as indicated on the plans or naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No.200 sieve.
- F. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No.8 sieve.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No.4 sieve.
- H. Topsoil: Topsoil shall consist of stripping material excavated from the site. Topsoil shall consist of organic surficial. Topsoil shall be as further defined in Section 02900 – Planting.

2.2 APPURTENANT MATERIALS

- A. Stabilization fabrics and geogrids: As specified in Section 02340.
- B. Filter and drainage fabrics: As specified in Section 02340.
- C. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on The Drawings.
- D. Trench Utility Locator Tape: Heavy duty 6" wide underground warning tape. Tape shall be made from polyethylene material, 3.5 mils thick, with a minimum tensile strength of 1,750 psi. Place the tape at one-half the minimum depth of cover for the utility line or a maximum of 3 feet, whichever is the less, but never above the top of subgrade. Color of tape shall be determined by as follows:
 - 1. Natural Gas or Propane – Yellow.
 - 2. Electric – Red.
 - 3. Telephone – Orange.
 - 4. Water – Blue.
 - 5. Sanitary Sewer – Green.

2.3 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

2.4 SOURCE QUALITY CONTROL

- A. Laboratory testing of materials proposed for use in the project shall be by the Wal-Mart Construction Testing Laboratory at no cost to Contractor. The Contractor shall provide samples of material obtained off-site.

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- B. Perform California Bearing Ratio (CBR) tests in outparcels and areas to receive pavement for each type of material that is imported from off-site. CBR value shall be equal to or above pavement design subgrade CBR value indicated on Construction Drawings.
- C. Following tests shall be performed on each type of on-site or imported soil material used as compacted fill:
 - 1. Moisture and Density Relationship: ASTM D1557.
 - 2. Mechanical Analysis: AASHTO T88 or ASTM D422.
 - 3. Plasticity Index: ASTM D4318.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, datum, elevations, and grades necessary for construction as shown on the drawings.
- B. Notify utility companies to remove or relocate public utilities that are in conflict with proposed improvements.
- C. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs, unless otherwise noted on the drawings from excavating equipment and vehicular traffic.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- E. Remove from site, material encountered in grading operations that is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.
- F. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
 - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.
 - 2. After drainage of low area is complete, remove muck, mud, debris, and other unsatisfactory material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.
 - 3. All muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation. Material shall be inspected and, if found to be satisfactory for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under building subgrade or within 5'-0" of perimeter of building subgrade, paving or outparcel subgrade. If, after observation, material is found to be unsatisfactory, it shall be removed from site.
- G. Locate and identify utilities that have previously been installed and protect from damage.
- H. Locate and identify existing utilities that are to remain and protect from damage.
- I. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on the Drawings.
- J. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on the Drawings.
- K. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or aggregate material placed and compacted as specified in Section 02340.

3.2 DEWATERING

A. General:

1. Dewatering activities shall conform to applicable provisions in 02370.
2. Provide dewatering systems as required for excavations.
3. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a "quick" or "boiling" condition. System shall not be dependent solely upon sumps or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability.
4. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow Work to be installed in a dry condition.
5. Control, by acceptable means, all water regardless of source. Contractor shall be responsible for disposal of the water.
6. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary, lower water level in advance of excavation utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.
7. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.
8. Open pumping with sumps and ditches will be allowed provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.
9. Install wells or wellpoints, if required, with suitable screens and filters so that continuous pumping of fines does not occur. Arrange discharge to facilitate collection of samples by the Owner. During normal pumping and upon development of wells, levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.
10. Control grading around excavations to prevent surface water from flowing into excavation areas.
11. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.

B. Design:

1. Designate and obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work.
2. Contractor shall be responsible for the accuracy of the drawings, design data, and operational records required.
3. Contractor shall be responsible for the design, installation, operation, maintenance, and any failure of any component of the system.

C. Damages:

1. Contractor shall be responsible for and shall repair any damage to work in place, other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation. Contractor responsibility shall also include, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
2. Remove subgrade materials rendered unsatisfactory by excessive wetting and replace with approved backfill material at no additional cost to the Owner.

D. Maintaining Excavation in Dewatering Condition:

1. Dewatering shall be a continuous operation. Interruptions due to power outages or any other reason will not be permitted.
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails.

If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.

4. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components and any other work required to maintain excavation in dewatered condition.

E. System Removal: Upon completion of the work, remove dewatering equipment from the site, including related temporary electrical service.

F. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

3.3 TOPSOIL EXCAVATION

A. Cut heavy growths of grass from areas before stripping and remove cuttings with remainder of cleared vegetative material.

B. Strip topsoil from areas that are to be filled, excavated, landscaped, or re-graded to such depth that it prevents intermingling with underlying subsoil or questionable material.

C. Stockpile topsoil in storage piles in areas shown on The Drawings or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Remove excess topsoil from site unless specifically noted otherwise on the Drawings.

3.4 GENERAL EXCAVATION

A. Classification of Excavation: The Contractor shall assure himself by site investigation or other necessary means that he is familiar with the type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated in the Contract Documents.

B. When performing grading operations during periods of wet weather, provide adequate dewatering, drainage and ground water management to control moisture of soils.

C. Shore, brace, and drain excavations as necessary to maintain excavation as safe, secure, and free of water at all times.

D. Excavate building areas to line and grade as shown on the Drawings being careful not to over excavate beyond elevations needed for building subgrades.

E. Place satisfactory excavated material into project fill areas.

F. Unsatisfactory excavated material shall be disposed of in manner and location that is acceptable to Owner and local governing agencies.

G. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.5 ROCK EXCAVATION

A. Rock excavation is specified in Section 02318.

3.6 TRENCHING EXCAVATION FOR UTILITIES

A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to

avoid point-bearing. Over-excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding. Replace over-excavation with satisfactory material and dispose of unsatisfactory material.

- B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.
- C. Perform trench excavation as indicated on the Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not satisfactory as backfill or embankments and waste off-site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 02220.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified.
- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width below top of pipe shall not be less than 12 inches nor more than 18 inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:
 - 1. Water Mains: 30 inches to top of pipe barrel or 6 inches below frost line, established by local building official, whichever is deeper.
 - 2. Sanitary Sewer: Elevations and grades as indicated on the drawings and as specified in Section 02535.
 - 3. Storm Sewer: Elevations and grades as indicated on the Drawings.
 - 4. Electrical Conduits: 24 inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
 - 5. TV Conduits: 18 inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 - 6. Telephone Conduits: 18 inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 - 7. Gas Mains and Service: 30 inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.7 SUBGRADE PREPARATION

- A. Scarification and Compaction: The exposed subgrade soil should be scarified, moisture conditioned, and compacted. The depth of scarification of subgrade soils and moisture conditioning of the subgrade is highly dependent upon the time of year of construction and the site conditions that exist immediately prior to construction. If construction occurs during the winter or spring, when the subgrade soils are typically already in a moist condition, scarification and compaction may only be 8 inches. If construction occurs during the summer or fall when the subgrade soils have been allowed to dry out deeper, the depth of scarification and moisture conditioning may be as much as 18 inches or more. The geotechnical engineer should be present to observe the

exposed subgrade and specify the depth of scarification and moisture conditioning required subsequent to grading cuts and prior to placing fill.

Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified, moisture conditioned and compacted to at least 95% Maximum Dry Density as obtained by the Standard Proctor Method (ASTM 1557), moisture conditioned within optimum and 3% above the optimum moisture content.

- B. Proofrolling: Subgrades shall be proofrolled to detect areas of insufficient compaction and soft pocket, or areas of excess yielding. Proofrolling shall be accomplished by making minimum of two complete passes with fully-loaded tandem-axle dump truck with a minimum weight of 20 tons, or approved equal, in each of two perpendicular directions. Limit vehicle speed to three mph. Areas of failure such as soft spots, unsatisfactory soils, and areas of excessive pumping or rutting shall be excavated and re-compacted as specified herein. Continual failure areas shall be stabilized in accordance with Section 02340 at no additional cost to Owner. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled. Document proofrolling procedure, specific locations, deficiencies, and corrective measures for review by Owner or Owner's CTL upon request.

3.8 FILLING

- A. Fill areas to contours and elevations shown on the Drawings with materials deemed satisfactory.
- B. Place fills in continuous lifts specified herein.
- C. Fill within proposed building subgrade, paving subgrade, and outparcel subgrades shall not contain rock or stone greater than 6 inches in any dimension.
- D. Unless otherwise specified for rock fill, rock or stone less than 6-inches in largest dimension may be used in fill below structures, paving, outparcels, and graded areas, up to 24 inches below surface of proposed subgrade or finish grade of graded areas when mixed with satisfactory material. Rock or stone less than 2 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with satisfactory material.
- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 10 inches loose measure and compacted as specified hereinafter.
- F. Material imported from off-site shall have CBR or LBR value equal to or above pavement design subgrade CBR or LBR value indicated on The Drawings.
- G. Building area subgrade pad shall be that portion of site directly beneath and 5 feet beyond building and appurtenances, including limits of future building expansion areas as shown on the Drawings.
- H. Prepare building area subgrade pad in strict accordance with "Foundation Subsurface Preparation" as shown on the Drawings. The Foundation Subsurface Preparation provisions shall take precedence over the provisions of this section whenever duplication or conflict occurs.

3.9 ROCK FILL

- A. Rock fill shall include on-site excavated material classified as rock excavation as specified in Section 02318. Rock fill may be utilized in fill up to 48 inches below top of subgrade or finish grade of graded areas outside the proposed building, paving, and outparcel areas. Rock fill shall consist of rock having a maximum dimension not greater than 12 inches in any dimension. Rock fill shall be placed in successive horizontal layers of loose material having a thickness of approximately the maximum size of the larger rock in the lift, but not greater than 12 inches. Each layer of material shall be spread uniformly, completely saturated, and compacted. Shot rock shall not be dumped into place, but shall be distributed in horizontal lifts by blading and dozing in such a manner as to ensure proper placement into final position in the embankment. Voids shall be filled with finer material including shot rock fines and limited soil fines during the spreading operation. Successive layers shall not be placed until all

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voids of the current lift are filled and the lift is compacted. Each successive layer of material shall adequately bond to the material on which it is placed. Compaction shall be accomplished with vibratory compactors, heavy rubber-tired rollers, or steel-wheeled rollers. Compaction shall be by uniform passes of compaction equipment in sufficient number of passes, but not less than two passes, such that no further consolidation is evident.

3.10 PIPE BEDDING

- A. Excavate trenches for pipe or conduit to 4 inches below bottom of pipe and to the width as specified herein. Place 4 inches of bedding material, compact in bottom of trench, and shape to conform to lower portion of pipe barrel.
- B. Place geotextile fabric as specified on the Drawings and in accordance with Section 02340.

3.11 TRENCH BACKFILLING

- A. Materials used for trench backfill shall comply with requirements as specified herein.
- B. Backfill and compact in accordance with fill and compaction requirements in ASTM D2321 unless otherwise shown on the drawings.
- C. Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities.
- D. Backfill trenches to contours and elevations shown on the Drawings.
- E. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.12 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

- A. When indicated by the Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 95 percent of maximum density in accordance with ASTM D1557 obtained at optimum moisture as determined by AASHTO T180. Mechanical tampers may be used after cover of 6 inches has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2 inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.
- D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area.
- E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt coating in accordance with and governing authorities.
- F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.13 COMPACTION

- A. Compact as follows:

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<u>Location</u>	Percent of Maximum Laboratory Density <u>ASTM D1557</u>
Subgrade & Fill below Structures, Pavement and Outparcels	95
Subgrade & Fill in All other Areas	92

- B. Maintain moisture content between optimum and 3% above the optimum moisture content of fill materials to attain required compaction density.
- C. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- D. Corrective Measures for Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained. Continual failure areas shall be stabilized in accordance with Section 02340 at no additional cost to Owner.

3.14 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material with CBR or LBR equal to or better than that specified on the drawings. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross-section.
- D. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from subgrade at all times.

3.15 BORROW AND SPOIL SITES

- A. Comply with NPDES and local erosion control permitting requirements for any and all on-site and off-site, disturbed spoil and borrow areas. Upon completion of spoil or borrow operations, clean up spoil or borrow areas in a neat and reasonable manner to the satisfaction of Owner or off-site property owner, if applicable.

3.16 FINISH GRADING

- A. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Allowable tolerance shall be plus or minus 0.10 feet from plan grade. Provide engineering and field staking as necessary for verification of lines, grades, and elevations.
- B. Grade areas where finish grade elevations or contours are indicated on the Drawings, other than paved areas, outparcels, and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Ground surfaces shall vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without ponding and in manner that will minimize erosion potential. For topsoil, sodding, and seeding requirements refer to Section 02900.
- C. Correct settled and eroded areas within 1 year after date of completion at no additional expense to Owner. Bring grades to proper elevation.

3.17 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Except for specified mandatory testing, field quality control testing and inspection shall be at the discretion of the Contractor

as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

3.18 OWNER TESTING AND INSPECTION (T&I) AND OBSERVATION

- A. The Owner will perform testing and inspection (T & I) as specified in Appendix B (Section 02300).
- B. Civil Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

SECTION 02318 (31 2316) - ROCK EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal including, drilling, blasting, and protection of rock excavation.

B. Related Requirements:

1. Section 02230 – Site Clearing. Clearing of trees, brush, and vegetation prior to excavation.
2. Section 02300 – Earthwork: Excavation, filling, and compaction of earth materials and rock fill.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. National Fire Protection Association (NFPA)

1. NFPA495 - Code for Manufacturing, Transportation, Storage, And Use of Explosive Material

C. United States Department of Interior, Bureau of Mines

1. Seismic Effects of Blasting

D. Occupational Safety & Health Administration (OSHA)

1. 29CFR1910.109 - Explosives and Blasting Agents

E. State of California Department of Transportation (CALTRANS)

1. 2018 Standard Specifications

F. City of Stockton Standard Specifications

1.3 DEFINITIONS

- A. Rock Excavation: Removal of igneous, metamorphic, or sedimentary rock or stone, boulders over two cubic yards in volume in open areas and one cubic yard in volume in trenches; and masonry, concrete, or solid frozen soil that cannot be removed by rippers or other mechanical methods and, therefore, requires drilling and blasting.
 1. The excavation and disposal of all "Rock Excavation" that is indicated by the Soils Report shall be considered unclassified excavation and shall be included with site work grading as part of the lump sum base bid.
 2. If "Rock Excavation" is required that is not indicated by the Soils Report, the Wal-Mart Construction Manager shall be notified prior to such rock excavation, and he must then visit the site and verify the necessity for excess "Rock Excavation," determine an estimated quantity and provide the Contractor written approval to proceed. In the event the estimated quantity is exceeded, the Wal-Mart Construction Manager shall again be notified to establish a revised estimated quantity and authorize the Contractor to proceed. Payment for the authorized work shall be by a Change Order to the Contract.
- B. Trenches: Excavations having vertical sides whose depths exceed its width, made for storm water drainage, sanitary sewer, water, and gas pipes, electric, communications, and steam conduits, and related uses.

1.4 SUBMITTALS

- A. Submit Blasting Plan prior to any blasting and Monitoring Reports to the Owner and Governing Agencies for review.

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1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA495, Bureau of Mines Seismic Effects of Blasting, and OSHA 29CFR1910.109 as applicable.
- B. Comply with all applicable laws, rules, ordinances and regulations of the Federal, State and local regulatory authorities and insurers that govern the licensing, transportation, storage, handling, use, and disposition of explosives.
- C. Prior to rock excavation, obtain and pay for all powder and blasting permits and licenses from regulatory agencies.
- D. If blasting is required or undertaken, the responsible Subcontractor shall be licensed in the State and shall possess a current blasting license issued by the appropriate regulatory authority and be permitted for the transportation of explosives if required.
- E. In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable codes, regulations or Specifications.

1.6 SITE CONDITIONS

- A. Environmental Requirements: Determine environmental effects associated with proposed work and safeguard those concerns as regulated by law and local governing agencies by reasonable and practical methods.
- B. Existing Conditions: The Contractor shall be responsible for any and all damage and/or injury from the use of explosives. The Contractor shall save and hold harmless the Owner, Architect and Engineer from any and all claims from the use of explosives. Removal of materials of any nature by blasting shall be done in such a manner and at such times as to avoid damage affecting integrity of existing construction and damage to new or existing dwellings, structures and water wells in or adjacent to the area of the work. It shall be the Contractor's responsibility to determine the method of operation to ensure desired results and integrity of completed work. All damage caused by the Contractor's blasting operations shall be repaired to the full satisfaction of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Explosives, detonator/delay device, and blast mat materials shall be type recommended by explosive supplier and shall comply with requirements specified herein.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify site conditions and note subsurface conditions affecting work of this section.
- B. Identify required lines, levels, and elevations that will determine extent of proposed removals.

3.2 ROCK EXCAVATION

- A. Cut rock to form level bearing at bottom of footing and trench excavations. Remove shaled layers to provide sound and unshattered base for footings or foundations. Contractor shall consider reuse of excavated materials on site in accordance with Section 02300. If material cannot be utilized on site, dispose of material offsite.
- B. If placed in embankments, perform rock excavation in manner that will produce material of such size as in accordance with Section 02300. Remove rock to allow for construction and/or installation of the site and building improvements as indicated on Construction Drawings. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.

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- C. Use lean concrete or suitable materials as directed by registered geotechnical engineer to replace rock overblast or over excavation in building and expansion area to facilitate placement of utilities and foundations systems.

3.3 ROCK BLASTING

A. General

1. The drilling and blasting methods and programs shall be those necessary to accomplish any and all rock excavation required for completion of the improvements shown on the Construction Drawings in accordance with the procedures specified herein. Do not use explosives as a primary means of transporting material outside the excavated prism.
2. Blasting work shall be performed only with necessary permits from all regulatory authorities and after completion of the preblast survey. Blasting work shall take place only after persons in the vicinity have been notified and have reached positions of safety. Take appropriate precautions to prevent all persons from entering the blasting area. Use methods and programs that will prevent damage to, but not limited to, adjacent dwellings, structures, public domain, natural resources, habitat, existing wells and landscape features and that will minimize the scattering of rock, stumps or other debris. All affected roadways shall be inspected, cleared, and opened to traffic within 1 hour of completed blasting or as required by governing authorities.
 3. Complete all blasting with experienced powdermen licensed to use explosives in the State.
4. Conduct blasting at such hours (between ___ a.m. to ___ p.m.) so as not to disrupt surrounding residences and businesses, and in accordance with Federal, state and local regulations and/or ordinances with regard to noise.
5. Take all precautions necessary to warn and/or protect any individuals exposed to his operations prior to any blasting. Blasting mats or other approved flyrock protection shall be employed as necessary to protect areas adjacent to blasting.
6. Develop and maintain records covering pertinent data on the location, depth and area of the blast, the diameter, spacing, depth, overdepth, pattern, amount, distribution and powder factor for the explosives used per hole and per blast; the sequence and pattern delays, and description and purpose of special methods. Provide a copy of the records to the Owner upon the Owner's request. Receipt and acceptance by the Owner of blasting data will not relieve the Contractor of responsibility to produce satisfactory results as set forth in these specifications. Drilling and blasting shall be done only to the depth, amount and at such locations, with explosives of such quantity, distribution, and density that will not produce unsafe or damage rock surfaces or damage rock beyond the prescribed excavation limits. The Contractor shall be responsible for the cost of removal of overblast and also for the cost of placement and compaction of suitable replacement fill where overblast removal is required or occurs.
7. When a drilling and blasting program results in damage to the excavation or unacceptable peak particle velocity or frequency values as specified herein, the Contractor will be required to devise and employ revised methods that will prevent such damage or unacceptable ground motions at no cost to the Owner. The revisions may include special methods such as presplit and zone blasting, shallow lifts, reduction in size of individual blasts, small diameter blast holes, closely spaced blast holes, reduction of explosives, greater distribution of explosives by use of decking and primacord or variation in density of explosives and chemical or mechanical splitting of the rock.

B. Explosives

1. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, utility lines, or other subsurface structures.
2. Store, handle, and employ explosives in accordance with Federal, state and local regulations, or, in the absence of such, in accordance with the provisions of the NFPA and OSHA.

C. Blasting Vibration And Limit Criteria

1. The amount of vibration, frequency and overpressure generated by blasting shall not exceed regulatory statutes or directives established by State, local or other authorities. In no case shall the maximum Peak Particle Velocity (PPV) exceed the limits indicated on Figure B-1, Appendix B, of the United States Bureau of Mines Report of Investigations, RI 8507, 1980 or latest edition.
2. The peak airblast overpressure measured at the location of the nearest occupied, aboveground structure (considering wind direction) shall not exceed 0.014 psi.

D. Preblast Survey

1. General:

- a. Conduct a preblast survey prior to initiating blasting work. Preblast survey shall be performed by a registered Professional Engineer or specialized consultant licensed in the State of the work covered under this contract and specialized in conducting preblast surveys.
- b. The preconstruction/preblast survey shall consist of documenting conditions of all existing dwellings and structures located within a minimum of 500 feet of the limits of all work requiring rock blasting prior to commencement of blasting or further if required by Federal, state or local regulations.
- c. The purpose of the preblast survey is to determine the conditions of existing dwellings, structures and water supply wells and document any pre-existing defects and other physical factors that could reasonably be affected by the blasting. Structures such as dams, ponds, pipelines, cables and transmission lines, cisterns, structures of historical significance, and/or structures with unusually costly or vulnerable contents shall be included. The preblast survey shall also note the nature and sensitivity of livestock that may be affected by the blasting.

2. Examination of and Preparation for Survey:

- a. The Contractor shall contact the property owners (or their legal representative) of properties within a minimum of 500 feet of the limits of all blasting work in order to obtain permission to conduct a survey of their property. If the property owner does not grant the Contractor permission to conduct the survey, the Contractor shall contact the property owner a second time by registered mail/return receipt requested. The second request for permission to conduct the survey shall include a description of the survey to be performed and the purpose of the survey. At least 72 hours prior to start of blasting work, notify the appropriate local regulatory authority of any property owners who refuse access for the preconstruction survey.
- b. Notify the property owners at least 48 hours prior to conducting the preblast survey. After completion of the survey, two copies of the preblast report shall be submitted to the appropriate local regulatory authority for their reference if required. Additionally, one copy shall be kept on file at the location of the project and one copy provided to the Owner upon request.

3. Method:

- a. The preblast survey shall include a detailed examination of the interior and exterior of structures located within a minimum of 500 feet of the limits of blasting work. Color photographs, videotapes, and written descriptions shall be taken as required to document the condition of areas within the limits of the survey area. Particular note shall be made of evident structural faults or deficiencies, or recent repairs.
- b. The preblast survey shall also include an assessment of water supply wells located within a minimum 500 feet of the limits of all blasting work. This assessment shall include the following items:
 - 1) Information regarding the date of construction of the well, depth, method of construction, yield, water quality and any other existing available data will be requested from each well owner and/or the installer, provided the installer is known.
 - 2) A short duration pump test shall be performed on each well utilizing the existing pump that services each well. The pump shall be activated, the volume of water measured and the drawdown in the well measured for a 1-hour or less period until approximate steady state conditions are achieved. The data obtained from these measurements shall be used to estimate the approximate yield of each well.
 - 3) Upon completion of the above-described short duration pump test, obtain a groundwater sample from the well and submit to a State certified water quality laboratory. Laboratory shall analyze sample for iron, manganese, total dissolved solids, turbidity and total coliform.

4. Survey Report:

- a. The Contractor shall prepare a written report summarizing the results of the preblast survey. The final written report shall be signed and sealed by the Contractor's qualified inspector. The report shall contain the following:
 - 1) Location and description of each property
 - 2) Descriptions of the conditions of the on-site elements
 - 3) Summary of the visual inspection
 - 4) Color photographs, sketches, and videotape with vocal summary
 - 5) All data developed from the water supply well assessment
- b. Provide videotapes to include supplemental information, as required. Pictorial documentation shall be of professional quality and shall be provided with a scale, where practicable. Clearly label picto-

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rial documentation with an identification number, name of the project and the Engineer or qualified person conducting the survey, name of the property owner, date the picture or video tape was taken, and sufficient information to determine the location of the area in question.

- c. The Contractor's inspector shall immediately report in writing to the Contractor any findings that, in his opinion, indicate that any structure or well will be adversely affected by the required construction and blasting.
- d. If, during the course of construction and blasting, the Contractor is requested by an adjacent property owner to view alleged damage to property, the Contractor shall give written notice to the Owner prior to the Contractor's visit to the adjacent owner's property.

E. Blast Monitoring:

- 1. Contractor shall perform seismic blast monitoring in accordance with State and local regulations.
- 2. Contractor shall provide monitoring of blasting vibrations and over-pressures to allow evaluation of compliance with the specified vibration/over-pressures to criteria. As a minimum, the Contractor will monitor each blast as follows:
 - a. Monitor vibrations at the exterior walls of all structures within 500 feet of each blast location.
 - b. If no structures are located within 500 feet of the blast location, monitor vibrations at three equally spaced radial points located a minimum of 500 feet from the blast locations.
 - c. Monitor over-pressures for all structures within a minimum 500 feet of the blast.
- 3. If requested by the Owner, report vibration/overpressure-monitoring results to the Owner within two hours of blasting. Monitoring performed by the Contractor does not relieve the Contractor of responsibility for control of vibration and overpressure during blasting operations.

3.4 ROCK CUT FACE EXCAVATION

- A. The slope of the soil above the top of any permanently exposed rock cut face shall be no steeper than 3(H):1(V) unless otherwise noted on the Construction Drawings. Slope of the rock face shall meet the requirements below.

TYPE OF ROCK	SLOPE (Horizontal to Vertical)
Solid limestone or sandstone	_____
Interbedded limestone, sandstone or shale	_____
Layered shale (no hard rock)	_____

- B. Benches of at least ten feet in width at a maximum of twenty feet in elevation intervals or as noted on the Construction Drawings. The benches shall serve to provide rock traps and divert water from the rock face.

3.5 ROCK TRAP

- A. Locate rock traps at the base of permanently exposed rock slopes and construct as indicated in the Construction Documents or Blasting Plan.

3.6 OVEREXCAVATION AND BACKFILL

- A. Over excavation which is required to remove unsuitable natural undisturbed bedrock weakened by weathering or other cause not inflicted by the Contractor shall be immediately reported to the Owner and performed as directed by the Owner, and the theoretical lines and grades will be adjusted accordingly. Material outside the excavation limits which are disturbed due to the fault or negligence of the Contractor or due to his failure to exercise sound construction practices, shall be either replaced by the Contractor with suitable materials (earth or concrete), or bolted, or both as directed, at no cost to the Owner.

END OF SECTION

SECTION 02340 (31 3200) - SOIL STABILIZATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, treatment, and backfilling of subgrade for lime, cement, fly ash, or bridge lift stabilization.
 - 2. Geotextile fabric and geogrid for stabilization of subgrade.
- B. Related Requirements:
 - 1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
 - 2. Section 02300 – Earthwork
 - 3. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C150 - Portland Cement.
 - 2. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
 - 3. ASTM C977 - Quicklime and Hydrated Lime for Soil Stabilization.
- C. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M216 - Lime for Soil Stabilization.
- D. National Lime Association (NLA):
 - 1. NLA Bulletin 326 - Lime Stabilization Construction Manual.
- E. State of California Department of Transportation (CALTRANS):
 - 1. 2018 Standard Specifications
- F. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees Fahrenheit.
- B. Minimize dust emissions or provide equipment that suppresses dust.
- C. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

1.4 SUBMITTALS

- A. Submit 30-pound sample of each material to be used at the site in airtight containers to the Construction Testing Laboratory (CTL) or submit gradation and certification of material that is to be used to the CTL for review.

- B. Submit name of each materials supplier and specific type and source of each material. Obtain approval of Owner prior to change in source.
- C. Submit mix designs, materials mix ratio, and laboratory test data to the Civil Engineering Consultant of Record 4 weeks prior to beginning stabilization activities. Certify materials and mix ratios will achieve the specified requirements as indicated in the Construction Documents or as specified by state and local agencies for soil stabilization if not stated in the Construction Documents.
- D. Submit approved mix designs, materials mix ratio, and laboratory test data to the CTL prior to commencing stabilization activities.

PART 2 PRODUCTS

1.5 MANUFACTURERS

- A. Provide products from one of the following manufacturers as specified in the Materials paragraph below:
 1. TenCate Geosynthetics North America (Mirafi), Pendergrass, GA., (706) 693-2226, www.tencate.com
 2. Hanes Geo Components (WEBTEC), Winston Salem, NC. (336) 747-1600, www.hanesgeo.com
 3. Tensar International Corp., Atlanta, GA. (888) 828-5126, www.tensarcorp.com
 4. Thrace-LINQ Inc., Summerville, SC (843) 873-5800, www.thracelinq.com
 5. DuPont (Tytar). Summerville, SC (843) 832-6860, www.typargeo.com
 6. Synteen Technical Fabrics, Lancaster, SC (800) 796-8336, www.synteen.com

1.6 MATERIALS

- A. Soil Treatment Materials:
 1. Hydrated Lime: ASTM C977 or AASHTO M216.
 2. Portland Cement: ASTM C150, Type I.
 3. Fly Ash: ASTM C618.
- B. Aggregate:
 1. Coarse Aggregate: Crushed carbonate, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slag, or other types of suitable material meeting the following gradation requirements:

Sieve Size	Percent Passing
2 inches	100
1 inch	70-100
3/4 inch	50-90
No. 4	30-60
No. 30	7-30
No. 200	0-5

2. Fine Aggregate: Sand – Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter meeting the following gradation requirements:
- 3.

Sieve Size	Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-5

- C. Subsoil: Existing to be reused.
- D. Bridge Lift Material: Surge stone, granular fill, or shot rock fill.

1.7 ACCESSORIES

- A. Curing Seal: Asphalt Emulsion Primer.

- B. Geotextile Fabric for Stabilization: Provide one of the following:
 1. Mirafi HP 370 or HP 570, by TenCate.
 2. SF40 or SF65, by DuPont.
 3. GTF-200 or 300, by Thrace-LINQ.
 4. TerraTex HD, by Hanes.

- C. Geogrid for Stabilization: Provide one of the following:
 1. Biaxial Geogrid Type 1 (formerly BX 1100), by Tensar.
 2. Biaxial Geogrid Type 2 (formerly BX 1200), by Tensar.
 3. Mirafi BXG 11, by TenCate.
 4. Mirafi BXG 12, by TenCate.
 5. SF 11, by Synteen.
 6. SF 12, by Synteen.

PART 3 EXECUTION

1.8 PREPARATION

- A. Obtain approval of mix design before proceeding with placement.

- B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.

- C. Proofroll subgrade to identify areas in need of stabilization.

1.9 EQUIPMENT

- A. Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting of material.

1.10 EXCAVATION

- A. Excavate subsoil to depth sufficient to accommodate soil stabilization.

- B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.

- C. Do not excavate within normal 45 degree bearing splay of any foundation.

- D. Notify Construction Manager of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.

- E. Correct areas over-excavated in accordance with Section 02300.

- F. Remove excess excavated material from site.

1.11 GEOTEXTILE FABRIC AND/OR GEOGRID

- A. Place geotextile fabric and/or geogrid over subsoil surface, lap edges and ends in accordance with manufacturer's recommendations in those areas that are shown on Construction Drawings or in those areas that need additional stabilization prior to placement of base course. Bridge lift sections may require the use of geotextile fabric and/or geogrid for stabilization prior to placement of fill.

- B. Place geotextile fabric and/or geogrid in accordance with manufacturer's recommendations.

1.12 SOIL TREATMENT AND BACKFILLING

- A. Lime Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with hydrated lime in accordance with state highway department specifications.
- B. Cement Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with Portland cement in accordance with state highway department specifications.
- C. Fly Ash Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with fly ash in accordance with state highway department specifications.
- D. Bridge Lifts: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade by application of a bridge lift. Bridging over existing soils shall be acceptable only when approved in writing by the Owner. Place geotextile fabric or geogrid over existing soils to be bridged. The geotextile fabric or geogrid selected shall be appropriate for the bridge lift material being placed. Place bridge lift over geotextile fabric or geogrid. Surge stone and shot rock will be approved by the Owner's representative on a submittal basis. The Owner and the Owner's representative shall have sole discretion as to the acceptability of all submittals.
- E. Backfill and compaction of treated subsoil shall be in accordance with Sections 02300.
- F. Maintain optimum moisture of mixed materials to attain required stabilization and compaction.
- G. Finish subgrade surface in accordance with Section 02300.
- H. Remove surplus mix materials from site.

1.13 CURING

- A. Immediately following compaction of mix, seal top surface with curing seal.
- B. Do not permit traffic for 72 hours after sealing top surface.

1.14 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor (except for specified mandatory testing listed below) as necessary to assure compliance with Contract requirements. Owner T&I shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, required, and customary testing and inspection of the methods and frequency suitable for the type of work involved.

1.15 OWNER TESTING AND INSPECTION (T&I) AND OBSERVATION

- A. The Owner will perform testing and inspection (T & I) as specified in Appendix B (Section 02340).
- B. Civil Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

SECTION 02375 (31 3700) – STONE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rip-rap, bedding, and filter fabric for stone slope protection.
- B. Related Requirements:
 - 1. Section 02300 – Earthwork: Geotextile fabric

1.2 REFERENCES

- A. State of California Department of Transportation (CALTRANS):
 - 1. 2018 Standard Specifications
- B. City of Stockton Standard Specifications

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rip-Rap: Stone for rip-rap shall consist of field stone or rough unhewn quarry stone as nearly uniform in section as is practical. Stones shall be dense, resistant to action of air and water, and suitable for purpose intended. Unless otherwise specified, stones shall weigh between 50 and 150 pounds each, and at least 60 percent of stones shall weigh more than 100 pounds each.
- B. Bedding Stone: Quarried and crushed angular limestone, 6-inches in depth, and with the following gradation:

Sieve Designation	% By Weight Passing Square Mesh Sieves
3"	100
No. 4	20-65
No. 200	0-10

- C. Filter Fabric: Geotextile fabric shall be as specified in Section 02340 and as detailed on Construction Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.
- B. Notify Construction Manager of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.
- C. Dress slopes and other areas to be protected to line and grade shown on Construction Drawings prior to placing of rip-rap. Undercut areas to receive rip-rap to elevation equal to final elevation less average diameter of stones before placing rip-rap.
- D. Correct areas over-excavated in accordance with Section 02300.

- E. Remove excess excavated material from site.

3.2 PLACEMENT

- A. Place rip-rap in areas where indicated on Construction Drawings.
- B. Install filter fabric and bedding stone prior to placement of rip-rap if so indicated on Construction Drawings.
- C. Place stones so that greater portion of weight is carried by earth and not by adjacent stones. Place stones in single layer with close joints. Upright areas of stone shall make angle of approximately 90 degrees with embankment slope. Place courses from bottom of embankment upward, with larger stones being placed in lower courses. Fill open joints with spalls. Embed stones in embankment as necessary to present uniform top surface such that variation between tops of adjacent stones shall not exceed 3 inches.

3.3 GEOTEXTILE FABRIC AND/OR GEOGRID

- A. Place geotextile fabric over subsoil surface, lap edges and ends in accordance with manufacturer's recommendations and as shown on the Drawings.

END OF SECTION

SECTION 02715 (32 1100) - BASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate base for asphaltic concrete including sand/shell base and hot-mix sand asphalt base.
- B. Related Requirements:
 - 1. Section 02300 – Earthwork: Excavation, Backfill, and Compaction for Pavement subgrade.
 - 2. Appendix B – Testing and inspection by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbs/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ft³ (2,700 kN-m/m³)).
- C. Asphalt Institute.
- D. State of California Department of Transportation (CALTRANS):
 - 1. 2018 Standard Specifications
- E. City of Stockton Standard Specifications, latest edition

1.3 QUALITY ASSURANCE

- A. A Construction Testing Laboratory (CTL) selected and paid for by the Owner, will be retained to perform construction testing on site at no cost to the Contractor. Contractor shall perform testing and inspections and be responsible for costs incurred, as necessary, to assure moisture content and gradation of materials imported to the site meet the specifications

1.4 SUBMITTALS

- A. Submit materials certificate to the Owner's Civil Engineering Consultant and the Owner's Construction Testing Laboratory, signed by materials producer and Contractor, certifying that materials comply with, or exceed, requirements specified herein or on the Construction Drawings.
- B. Submit certification of base course materials and placement as specified in Parts 2 and 3 hereinafter.

1.5 WEATHER LIMITATIONS

- A. Do not place aggregate when base surface temperature is less than 40 degrees F, nor when air temperature is below 45 degrees F. Do not place aggregate when surface is wet or frozen. Do not place aggregate when weather conditions are unfavorable otherwise.
- B.

PART 2 - PRODUCTS

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2.1 BASE COURSE MATERIAL

- A. Aggregate Base Course: Aggregate base course shall consist of a well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction. Base course may consist of a granular base (crushed slag, stone, or gravel, etc), sand/shell base material, or a hot-mix sand asphalt base.
- B. Base course shall be as shown on the drawings, or when not shown, shall be as specified herein.
- C. Aggregate base material requirements from State or other local highway agency specifications may be used for aggregate base course for roads, streets, or similar use pavements if the following conditions are met:
 - 1. Percentage of material by weight passing the No. 200 sieve will not exceed 10.
 - 2. Portion of the material passing the No. 40 sieve must have a liquid limit not greater than 25 and a plasticity index not greater than 5.
- D. Aggregate shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. Aggregate shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.
 - 1. Coarse aggregates shall be angular particles of uniform density.
 - 2. Fine aggregates shall be angular particles of uniform density. Fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.
- E. Gradation: The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 2 inches and shall be continuously well graded within the following limits:

GRADATION OF AGGREGATES
 Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

NOTE: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

- F. Hot-mix Sand Asphalt Bases: Asphalt Institute Type VI, VII, or VIII Mixes for Hot-mix Sand Asphalt Bases. Hot-Mix base shall be used only under asphaltic concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall verify to the Owner in writing that the subgrade has been inspected, tested, and gradients and elevations are correct, dry, and properly prepared in accordance with Section 02300.

3.2 CONSTRUCTION

- A. Perform base course construction in accordance with the applicable State standard specifications or as shown or specified.

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- B. Perform base course construction in a manner that will drain the surface properly and prevent runoff from adjacent areas from draining onto base course construction.
- C. Compact base material to not less than 98 percent of optimum density as determined by ASTM D698 or 95 percent of optimum density, as determined by ASTM D1557 unless otherwise indicated on the Drawings.
- D. Construct to thickness indicated on Construction Drawings. The minimum base thickness as shown on drawings shall be achieved throughout all pavement areas.
 - 1. Granular Base: Apply in lifts or layers not exceeding 8-inches, measured loose.
 - 2. Sand/Shell Base: Apply in lifts or layers not exceeding 4-inches, measured loose.
 - 3. Hot-mix Sand Asphalt Bases: Apply in lifts or layers not exceeding 3-inches, measured loose.

3.3 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor (except for specified mandatory testing listed below) as necessary to assure compliance with Contract requirements. Owner T&I shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. Mandatory Testing and Inspection:
 - 1. Measure base course tolerances no more than 25 ft. on center with a rod and level or stringline.
 - 2. Certify in writing to the Owner that base course placement is in accordance with Contract Document requirements prior to subsequent work thereon.

6.1 OWNER TESTING AND INSPECTION (T&I) AND OBSERVATION

- A. The Owner will perform testing and inspection (T & I) as specified in Appendix B (Section 02715).
- B. Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

SECTION 02740 (32 1216) - ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphalt concrete binder and surface course.
- B. Related Requirements:
 - 1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of hazardous construction and demolition waste.
 - b. Work practice control methods for airborne respirable dust
 - 2. Section 02300 - Earthwork.
 - 3. Section 02715 - Base Course.
 - 4. Section 02765 - Pavement Markings: Including removal of pavement markings.
 - 5. Section 02770 - Curbs and Sidewalks.
 - 6. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. The Asphalt Institute (AI):
 - 1. MS-2 - Mix Design Methods For Asphalt Concrete And Other Hot-Mix Types.
- C. State of California Department of Transportation (CALTRANS):
 - 1. 2018 Standard Specifications
- D. City of Stockton Standard Specifications
- E. ASTM International (ASTM):
 - 1. ASTM D1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
 - 2. ASTM D2041 - Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
 - 3. ASTM D2950 - Density of Bituminous Concrete in Place by the Nuclear Methods.
 - 4. ASTM D2726 - Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture.
 - 5. ASTM D5444 - Mechanical Size Analysis of Extracted Aggregate.
- F. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M017 - Mineral Filler for Bituminous Paving Mixtures.
 - 2. AASHTO M140 - Emulsified Asphalt.
 - 3. AASHTO M208 - Cationic Emulsified Asphalt.
 - 4. AASHTO M320 - Performance-Graded Asphalt Binder
 - 5. AASHTO M323 - Superpave Volumetric Mix Design
 - 6. AASHTO T164 - Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA)
 - 7. AASHTO T166 - Bulk Specific Gravity of Compacted Hot-Mix Asphalt Mixtures Using Saturated Surface-Dry Specimens
 - 8. AASHTO T209 – Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
 - 9. AASHTO T245 - Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 - 10. AASHTO T275 - Bulk Specific Gravity of Compacted Hot-Mix Asphalt Mixtures Using Paraffin-Coated Specimens
 - 11. AASHTO T308 - Asphalt Content of Hot-Mix Asphalt (HMA) by the Ignition Method.

12. AASHTOT312 - Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyrotory Compactor.
13. AASHTO T331 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

- G. National Asphalt Pavement Association (NAPA):
1. IS 123 – Recycling Hot-Mix Asphalt Pavements
 2. IS 128 - HMA Pavement Mix Type Selection Guide

- A. Occupational Safety and Health Administration (OSHA):
1. OSHA 01926.1153 Respirable Crystalline Silica.

1.3 QUALITY ASSURANCE

- A. Pre-installation Meeting: Convene a pre-installation meeting at the site at least two weeks prior to commencing work of this Section. Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, CTL's representative and inspector, Contractor, paving sub-contractor and job foreman.
1. Contact Wal-Mart Construction Manager three weeks prior to pre-installation conference to confirm schedule.
 2. Record discussions of meeting and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to paving work, including the following:
 - a. Review preparation and installation procedures and coordinating and scheduling required with related work.
 - b. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - c. Tour, inspect and discuss condition of subgrade, drainage structures, and other preparatory work.
 - d. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - e. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - f. Review paving requirements (drawings, specifications and other contract documents).
 - g. Review required submittals, both completed and yet to be completed.
 - h. Review required inspections, testing procedures.
 - i. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - j. Review safety precautions relating to placement of paving.

1.4 SUBMITTALS

- A. Submit mix designs to the Civil Engineering Consultant of Record at least 30 days prior to beginning asphalt paving operations. Mix designs over one year old will not be accepted by Owner. Mix design submittal shall follow the format as recommended by Asphalt Institutes Manual MS-2 and include the following:
1. Type and Name of mix.
 2. Gradation Analysis.
 3. Optimum asphalt content.
 4. Grade of asphalt binder.
 5. Volumetric properties.
 6. References to local State Highway Department Specification for each material when applicable.
 7. CALTRANS Mix Design Requirements from Section 30-4.01 of the Standard Specifications
 8. Certification Letter from Testing Laboratory verifying the quality Reclaimed Asphalt Pavement.
- B. Submit approved mix designs and laboratory test results to CTL signed by the materials producer and Contractor certifying materials and mix ratios conform to the requirements specified herein.
- C. Submit certification of asphalt placement as specified in Field Quality Control.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions or provide equipment that suppresses dust.

1.6 PROJECT CONDITIONS

- A. Weather Limitations:
 - 1. Apply tack coat when ambient or base surface temperature is above 40 F, and when temperature has been above 35 F for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, during rain, or when frozen.
 - 2. Construct asphalt concrete paving when ambient temperature is above 40 F.
- B. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aggregate: Use locally available materials and gradations that meet local State Highway Department Specifications and exhibit satisfactory records of previous installations. All aggregate requirements, including those for quality, shall meet those in AASHTO M323 for the specified traffic level.
- B. Asphalt Binder: Asphalt binder shall be a performance-graded (PG) binder, meeting the requirements of M 320, which is appropriate for the climate and traffic-loading conditions at the site of the paving project and in compliance with the local State Highway Department Specifications for that location, or as specified by the contract documents.
 - 1. Design reliability shall be 85% for the high- and low-temperature performance.
 - 2. The minimum required PG binder shall be that which satisfies the required design reliability using the pavement temperature data determined.
 - 3. The high-temperature grade shall be increased by one grade equivalent to accommodate low traffic speeds.
- C. Tack Coat: Emulsified asphalt; AASHTO M140 or AASHTO M208, SS-1h, CSS-1, or CSS-1h, may be diluted with up to 1 part water to 1 part asphalt.
- D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M17, if recommended by local State Highway Department Specifications.
- E. Reclaimed Asphalt Pavement (RAP): RAP may be used in accordance with Section 39-2.02B(5) of the CALTRANS Standard Specifications. The mix design shall contain the percentage of RAP that is to be used in the production. Higher proportions of RAP may be used upon approval with evidence showing specified quality of mix is retained. Production procedures using RAP material shall conform to NAPA IS 123. Additional RAP provisions shall be as follows:
 - 1. Material-handling machinery shall not drive on the RAP stockpiles.
 - 2. RAP maximum top size aggregate introduced into the mix shall be 1-1/2 inches.
 - 3. Dust (fines) in the RAP, when added to the virgin aggregate, shall not exceed the requirements of the virgin mix design.
 - 4. Moisture content shall be monitored to assure that the material can be thoroughly dried as it is processed.
 - 5. Stockpiles shall be left uncovered or stored under the roof of an open-sided building.
 - 6. Material handling front-end loader operators shall be experienced in handling RAP materials.
 - 7. RAP shall be loaded in the cold feed bins in small consistent quantities without causing the material to compact in the bin.
 - 8. RAP shall not be held in the bin for extended periods of time, especially on hot, humid days.
 - 9. During production, RAP material shall not be allowed to contact open flame.

2.2 AGGREGATE SIZE REQUIREMENTS - SUPERPAVE MIX

- A. Nominal Maximum Size The combined aggregate shall have a nominal maximum aggregate size of 4.75 to 19.0

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mm for surface courses and no larger than 25 mm for subsurface courses in accordance with Table 3 of AASHTO M323. Selection of the appropriate nominal maximum aggregate size mixture shall be in accordance with NAPA IS 128.

- B. Gradation Classification The combined aggregate gradation shall be classified as coarse-graded when it passes below the Primary Control Sieve (PCS) control point as defined in Table 4 of AASHTO M323. All other gradations shall be classified as fine-graded.

2.3 ASPHALT-AGGREGATE MIXTURE

- A. Hot-Mix Asphalt meeting City of Stockton Standard Specifications Section 39.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that the prepared base material has been inspected, tested, and gradients and elevations are correct, dry, and properly prepared in accordance with Section 02715.

3.2 PREPARATION

- A. Proof roll prepared base material surface to check for unstable areas in accordance with Section 02300 including documentation and re-proof rolling as required. Paving work shall begin only after unsuitable areas have been corrected and are ready to receive paving.
- B. Establish and maintain required lines and elevations.
- C. Cover the surfaces of curbs, gutters, manholes and other structures on which the asphalt concrete mixture will be placed, with a thin, uniform coat of liquid asphalt. Where the asphalt concrete mixture will be placed against the vertical face of an existing pavement, clean the vertical face to remove foreign substances and apply a coating of liquid asphalt at a rate of approximately 0.25 gallons per square yard.
- D. Density Control Strips.
 1. Prior to beginning placement of asphalt, construct asphalt concrete density control strips.
 2. Source and type of material, material requirements, and laydown and compaction equipment used for compaction shall be the same as that to be used in the project.
 3. The subgrade or pavement layer upon which the control strip is constructed shall tested prior to construction of the control strip.
 4. The control strip shall be a minimum of 250 linear feet long and one paver width wide.
 5. Rolling the control strip shall continue until no appreciable increase in density is obtained by additional coverages.
 6. Upon completion of rolling, the Contractor shall use a nuclear testing device to establish the mean density of the control strip. The mean density will be based on 10 tests taken at randomly selected sites within the control strip area. The nuclear gauge will be calibrated with the average of 3 cores taken from the same area. The average of the cores shall meet the specified density requirements. The calibration factor between the average nuclear density and average core density shall be applied to the Contractor's nuclear gauge for Contractor's density monitoring.
- E. Equipment:
 1. Equipment necessary for the paving of asphalt concrete shall be on the project prior to beginning paving operations.
 2. Maintain equipment in satisfactory operating condition and correct breakdowns in manner that will not delay or be detrimental to the schedule of paving operations.

3.3 APPLICATION

- A. Tack Coat:

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1. Apply to contact surfaces of previously constructed asphalt concrete base courses or Portland cement concrete and surfaces abutting or projecting into asphalt concrete or into asphalt concrete pavement.
2. Apply tack coat to asphalt concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphalt concrete and sand asphalt bases and on surface of bases where asphalt concrete paving will be constructed.
3. Apply at rate which produces a residual of asphalt cement between 0.04 and 0.06 gal per sq. yd of surface.
4. Allow drying until at proper condition to receive paving.

3.4 ASPHALT CONCRETE PLACEMENT

- A. Place asphalt concrete mixture on completed, compacted underlying surface, spread, and strike off. Spread mixture at the minimum ambient temperature that will allow the required density to be achieved.
- B. Whenever possible, spread pavement by finishing machine; however, inaccessible or irregular areas may be placed by hand methods. Spread hot mixture uniformly to required depth with hot shovels and rakes. After spreading, carefully smooth hot mixture to remove segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be type designed for use on asphalt mixtures. Do not dump loads faster that they can be properly spread. Workers shall not stand on loose mixture while spreading.
- C. Placement and routing of hauling and placing equipment shall be conducted in a manner to avoid tire tracking of bituminous material onto existing paved surfaces.
- D. Paving Machine Placement: Apply successive lifts of asphalt concrete in transverse directions except when placing within small areas, parallel lifts may be placed when considered more practical. Joints of successive parallel lifts shall be offset a minimum of 2 feet. Place surface course parallel to flow of traffic. Place asphalt paving in typical strips not less than 10'-0" wide. Asphalt concrete pavement, including base and surface course, shall be placed in two or more lifts as indicated on drawings. Pavement thicknesses shall be thickness shown on the drawings for each course but not less than 1-1/2 inch nor more than 3 inches for each lift.

3.5 ROLLING AND COMPACTION

- A. After being spread, mixture shall be compacted by rolling as soon as it will bear the weight of rollers without undue displacement. Number, weight, types of rollers, and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in workable condition.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Perform breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling with hot material.
- D. Intermediate Rolling: Follow breakdown rolling as soon as possible while mixture is hot. Continue second rolling until mixture has been thoroughly compacted as follows:
 1. Minimum Average Density: 93 percent of theoretical maximum density according to AASHTO T209 or ASTM D2041, with no individual test less than 91 percent nor greater than 97 percent.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked. Any masked or marred finish surfaces shall be repaired or smoothed.
- H. Compaction at Unsupported Edges of Pavements: Start the first roller pass 12-15 inches from the unsupported edge. Allow the uncompacted asphalt to act as a dike to hold the mat in place. The final pass over the uncompacted dike

should not slough off if the roller is supported on the compacted mat.

3.6 JOINTS

- A. General: Place each asphalt paving layer as continuous as possible to keep the number of joints to a minimum. Create joints between old and new pavement, between successive days work, and where the mixture has become cold (less than 140 degrees F). Make these joints in such a manner as to create a continuous bond between the old and new pavement construction courses.
- B. Construction joints shall have same texture, density, and smoothness as other sections of asphalt concrete course.
- C. Transverse Joints: If placing of material is discontinued or if material in place becomes cold, make a joint running perpendicular to the direction traveled by the paver. Before placement continues, trim the edge of the previously placed pavement to a straight line perpendicular to the paver and cut back to expose an even vertical surface for the full thickness of the course. When placement continues, position the paver on the transverse joint so that sufficient hot mixture will be spread in order to create a joint after rolling that conforms to the required smoothness. If the temperature of the previously placed pavement material drops below 140 degrees F before paving is resumed, give the exposed vertical face a thin coat of liquid asphalt just before paving is continued.
- D. Longitudinal Joints: Coat longitudinal joints that are not completed before the previously laid mixture has cooled to a temperature below 140 degrees F, with liquid asphalt just before paving is continued.

3.7 FIELD QUALITY CONTROL

- A. Responsibilities: Unless otherwise specified, the quality control tests and inspections specified below will be conducted by the Owner's Construction Testing Laboratory (CTL) at no cost to the Contractor in accordance with Section 01458. Field testing, frequency, and methods may vary as determined by and between the Owner and CTL. The Contractor shall perform additional testing or inspection as considered necessary by the Contractor for assurance of quality control including use of a nuclear density gauge to establish rolling patterns and monitor in-place density.
- B. Core Sampling and Testing: Asphalt surface and base courses shall be randomly cored at minimum rate of 5 cores per day's placement per mix type, but not less than 5 cores in light duty areas and 5 cores in heavy-duty areas shall be obtained. Asphalt concrete pavement samples shall be tested for conformance with density and thickness requirements. Cores shall be cut from minimal loading areas representative of project.
- C. Coring holes shall be immediately filled by the Contractor with full depth, hot-mix asphalt concrete or non-shrink grout tinted to match the surrounding pavement.
- D. Surface Smoothness Test: In areas of obvious depressions or bumps, suspect areas of each lift shall be checked with a 10'-0" straightedge both parallel with, and at right angles to, centerline of the paved area. The variation of the surface between two contact points shall not exceed 1/4-inch.
- E. Thickness Test: The Contractor shall measure pavement thickness behind the paver at the beginning of and during pavement placing operations to assure proper thickness. The CTL will measure thickness of each core sample taken. At each core location, the thickness of the course shall meet or exceed the thickness shown. If the thickness of a lower course of asphalt is less than the thickness shown, it shall be identified as a deviation and recorded. The Contractor shall either remove and replace the deficient pavement or increase the thickness of the upper course so that the total thickness of the pavement meets or exceeds the design thickness, provided that the specified compaction of the lower lift is achieved. If the Contractor elects to increase the thickness of the upper course, three additional cores shall be taken in the area after the upper course is laid to verify that the total thickness is achieved.
- F. Field density test for in-place materials:
 - 1. Density tests shall be conducted on each core sample taken in accordance with ASTM D1188 or D2726 (AASHTO T166, T275, T331) as applicable.
 - 2. In-place density tests by nuclear method in accordance with ASTM D2950 shall also be taken by the Contractor as necessary to assure the specified density is obtained. Nuclear density shall be correlated with ASTM D1188 or D2726 or AASHTO T166, T275, T331 as applicable.

3. Density tests on courses to be overlaid by subsequent courses shall be performed within 48 hours prior to placement of next lift. If inclement weather occurs after testing, retest prior to placement of next lift.
- G. Volumetric Properties: Obtain test samples from the truck at the asphalt plant. Mixture samples shall be taken at least 2 times for every 8 hour day.
1. Superpave Mix: Compact into specimens in accordance with AASHTO T312. Test each specimen for determination of relative density, VMA, VFA, and dust-to-binder ratio.
 2. Marshall Mix: Compact into specimens using compactive blows equal to mix design per side with the Marshall hammer as described in AASHTO T245. Temperature shall be equal to temperature at paving machine with reheating. Test each specimen for determination of laboratory air voids, Marshall stability, and flow.
- H. Check surface areas as necessary to identify ponding areas. Remove and replace unacceptable paving as directed by Owner.
- I. Asphalt Content and Aggregate Gradation: Asphalt content extraction and gradation of extracted aggregate testing shall be performed in accordance with AASHTO T 308 or AASHTO T164 and ASTM D5444 respectively and local State Highway Department Specifications requirements. At least two asphalt content and two gradation tests shall be taken for each 2000 tons or each day pavement is placed.
- J. Areas of deficient paving, including compaction, smoothness, thickness, and asphalt mixture, shall be delineated, removed, and replaced in compliance with specifications requirements. Alternative remedial or corrective measures for repair of deficient paving may be allowed provided a plan of corrective action is submitted in the form of a Request For Information (RFI) and the plan is approved by the CEC.
- K. The Contractor shall certify in writing that asphalt placement is in accordance with specification requirements.

END OF SECTION

Rev 10: (10/21/14) Revised Field QC par wording in Part 3. (WM/Urhahn) Updated BASF product names per vendor rebranding. (RHA/Waite) Clarified editor's note for Owner CTL to include responsibility for DOT requirements. (WM/Richards)

Rev 11: (04/24/15) Modified for T&I consolidation in Appendix B. (CI 128496)

Rev 12: (06/12/15) Clarified and added editor notes to reference CEC responsibility for special observations and coordinating with Appendix B. (WM/Richards)

Rev 13: (09/20/15) Revised Appendix B title to include "Observation." (WM/Urhahn) Revised sitework Appendix B title to "App B for CEC Edits." (WM/Richards)

Rev 14: (05/01/16) Added light pole bases to summary. Updated concrete mix requirements per code, including air content table, exposure reference. (CI 129288)

SECTION 02751 (32 1313) - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation and placement of Portland cement concrete parking areas.
2. Preparation and placement of Portland cement concrete roads and entrances.
3. Aggregate base below slab.
4. Exterior light pole bases.

B. Related Requirements:

1. Section 01330 - Submittal Procedures:
2. Section 02300 - Earthwork: Excavation, backfill, compaction for subgrades.
3. Section 02765 - Pavement Markings.
4. Section 03310 - Structural Concrete and Exterior Concrete Slabs: Truckwell slab, compactor and compressor equipment pads, drive-thru pharmacy driveway, and Automotive Center apron.
5. Appendix B – Testing, Inspection, and Observation by Owner.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Concrete Institute (ACI):

1. ACI 117 - Tolerances for Concrete Construction and Materials and Commentary.
2. ACI 301 - Structural Concrete.
3. ACI 305.1- Hot Weather Concreting.
4. ACI 306.1- Cold Weather Concreting.
5. ACI 308.1 - Curing Concrete.
6. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.

C. American Society for Testing and Materials (ASTM):

1. ASTM A 36 - Structural Steel.
2. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
4. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
5. ASTM C33 - Concrete Aggregates.
6. ASTM C 39 - Comprehensive Strength of Cylindrical Concrete Specimens.
7. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
8. ASTM C94 - Ready-Mixed Concrete.
9. ASTM C138 - Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
10. ASTM C143 - Slump of Hydraulic Cement Concrete.
11. ASTM C150 - Portland Cement.
12. ASTM C172 - Sampling Freshly Mixed Concrete.
13. ASTM C231 - Air-Content of Freshly Mixed Concrete by the Pressure Method.

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14. ASTM C260 - Air-Entraining Admixtures for Concrete.
15. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C403 - Time of Setting of Concrete Mixtures by Penetration Resistance
17. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
18. ASTM C920 - Elastomeric Joint Sealants.
19. ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1064 - Temperature of Freshly Mixed Portland Concrete Cement.
21. ASTM C1218 - Water-Soluble Chloride in Mortar and Concrete.
22. ASTM C1602 - Mixing Water used in the Production of Hydraulic Cement Concrete.
23. ASTM D98 - Calcium Chloride
24. ASTM D 698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. (2.49 Kg) Hammer and 12-in (305 mm) Drop.
25. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous).
26. ASTM D1241 - Materials for Soil-Aggregate Subbase, Base and Surface Courses
27. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
28. ASTM D1752: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
30. ASTM D3575: Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.

D. Federal Specifications (FS):

1. FS HH-F-341 - Fillers, Expansion Joint: Bituminous (Asphalt & Tar)

E. International Code Council, Inc.:

1. International Building Code (IBC).

F. AASHTO 1993 Method

1. Design of Pavement Sections

G. State of California Department of Transportation:

1. 2018 Standard Specifications

H. City of Stockton Standard Specifications

I. National Ready-Mixed Concrete Association:

1. NRMCA Inspection Standards

1.3 SUBMITTALS

- A. Submittal Procedures: Unless otherwise specified herein, submit in accordance with procedures specified in Section 01330.
- B. Obtain CEC approval for Mix Design and Pavement Joint and Placement Plan prior to commencement of work.
- C. Submit submittal items required within this section in a single submittal. Do not submit submittals of this section together with submittals in section 03310 or any other section. Identify submittals explicitly in accordance with Procedures paragraphs in Section 01330.
- D. Sieve Analysis for Aggregate Base: Submit current sieve analysis report, sampled and tested within the last 60 days of submittal date, for aggregate base and choker material.
- E. Concrete Batch Plant Certifications: Submit name and address of the concrete supplier's batch plant and plant certification(s) by National Ready-Mix Concrete Association and/or State Department of Transportation.
- F. Mix Design:
 1. Fill out and submit attached Concrete Mix Design Submittal Form.
 2. Submit three copies of each proposed mix.

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3. Submit separate mix design for concrete to be placed by pumping in addition to the mix design for concrete to be placed directly from the truck chute.
 4. Submit mix design to the Civil Engineering Consultant of Record, the Owner's Construction Testing Laboratory, and the Owner's Assigned Concrete Sub-Consultant.
 5. Include applicable information shown on the Mix Design Submittal Form and the following:
 - a. Proportions of cementitious materials, fine and coarse aggregate, and water.
 - b. Water-cementitious material ratio, 28-day compressive design strength, slump, and air content.
 - c. Type of cement, fly ash, slag and aggregate.
 - d. Aggregate gradation.
 - e. Type and dosage of admixtures.
 - f. Special requirements for pumping.
 - g. Range of ambient temperature and humidity for which design is valid.
 - h. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
 6. Materials and methods for curing concrete.
- G. Attachments to Concrete Mix Design: Submit the following as attachments to be included with the Concrete Mix Design:
1. Cementitious materials mill test reports for the following:
 - a. Portland cement
 - b. Fly ash
 - c. Slag
 2. Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials.
 3. Sieve Analysis Reports: Provide separate sieve analysis of percentages passing for coarse and fine aggregate. Show values for each sieve size shown on the mix design form. Do not leave any line blank. Sieve analysis sampling and testing for each aggregate source shall be conducted within 60 days of concrete submittal date.
 4. Aggregate Supplier Statement:
 - a. Stating if aggregate is possibly alkali-reactive based on tests or past service.
 - b. Stating if aggregate can possibly cause pop-outs, "D" cracking, or other disruptions due to moisture gain, freezing, or other mechanisms, based on tests or past service.
 5. Product data for the following concrete materials admixtures:
 - a. Water reducing
 - b. Set retarding
 - c. Set accelerating
 - d. Data indicating chloride ion content information for each admixture
 6. Concrete compressive strength data as required by ACI 318.
 7. Concrete supplier approval of mix design.
 8. Chloride-Ion Content: Measured water-soluble chloride-ion content (percent by weight of cementitious materials) in accordance with ASTM C1218.
 9. Time of Initial Setting: Initial setting time in accordance with ASTM C403.
- H. Product Data: Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Civil Engineering Consultant of Record and the Construction Testing Laboratory for review and approval and within 7 calendar days after receipt of Notice-to-Proceed. In addition, for projects with all-concrete parking lots, submit to the Wal-Mart Assigned Concrete Sub-Consultant.
1. Portland cement concrete mix design(s)
 2. Type and source of Portland cement, fly ash, and slag
 3. Aggregate gradations
 4. Joint back-up material
 5. Soft preformed joint filler
 6. Pavement joint sealant
 7. Dowel bars
 8. Tie bars
 9. Reinforcing steel bars
 10. Welded wire fabric
 11. Air entraining admixtures
 12. Water-reducing, set-retarding, and set-accelerating admixtures (if used)

- I. Pavement Joint and Placement Plan: For projects with all-concrete parking lots, provide a placement plan identifying the items listed below. In addition to submission to CEC, submit to Wal-Mart Assigned Concrete Sub-Consultant.
 - 1. Concrete truck access location.
 - 2. Extent of placements including width, length, slab placement area and volume.
 - 3. Locations of construction joints.
 - 4. Location of sawn contraction joints if different from those shown on the civil drawings.

- J. Pre-Slab Installation Meeting:
 - 1. Provide record of notification of pre-slab meeting including company name, persons contacted, and date and method of contact.
 - 2. Provide meeting minutes to all participants and Wal-Mart Construction Manager including sign-in sheet.

- K. Delivery Tickets:
 - 1. Copies of delivery tickets for each load of concrete delivered to site.
 - 2. Indicate information required by ASTM C 94 on each ticket including additional information required for slabs.
 - 3. Information on ticket shall include quantities of material batched including the amount of free water in the aggregate and the quantity of water that can be added at the site without exceeding the maximum water cementitious ratio of the approved mix design. Aggregate moisture corrections shall be based on ASTM definitions of aggregate moisture content and absorption.
 - 4. Mix identification number on ticket shall match number on submitted and approved mix design.
 - 5. Submit copies to Wal-Mart Testing Laboratory with each concrete delivery.

- L. Installation Certification: Submit certification in writing that final placement is in accordance with specification requirements.

- M. Statement of Approval of Concrete Supplier: Submit statement with information specified in Quality Assurance paragraph below.

1.4 QUALITY ASSURANCE

- A. Concrete Truck Inspection:
 - 1. Conform to ASTM C94, NRMCA, and Department of Transportation standards in state where project is located.
 - 2. Perform inspections immediately before starting concreting operations.
 - 3. Record acceptable truck numbers.
 - 4. Record the identification numbers of those trucks found to be acceptable on the basis of inspections.
 - 5. Do not bring on site for concreting operations, any truck whose identification numbers are not recorded as acceptable. Notify Wal-Mart Testing Lab if non-conforming trucks are used to deliver concrete for slabs and pavements.

- B. Tolerances:
 - 1. Conform to most stringent requirements of ACI 117 and ACI 301 except as specified herein.
 - 2. Conform to ACI 117 thickness tolerances for slabs-on-ground.

- C. Concrete Supplier Approval:
 - 1. The concrete supplier shall be fully approved and acceptable by the concrete subcontractor as the producer of concrete for which the subcontractor is to place and finish. Prepare Statement of Approval of Concrete Supplier stating project name, name of concrete supplier, along with the statement of approval and the signatures of the Contractor and concrete pavement subcontractor.

- D. Pre-installation Meeting: Convene a pre-installation meeting at the site at least two weeks prior to commencing work of this Section. Require attendance of parties directly affecting work of this Section, including, but not limited to, the Owner's representative, CTL's representative and inspector, Contractor, concrete sub-contractor and job foreman, concrete supplier, and base fine grading contractor.
 - 1. Contact Wal-Mart Construction Manager Thirty days prior to pre-installation conference to confirm schedule.

2. Record discussions of meeting and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. Review foreseeable methods and procedures related to paving work, including the following:
3. CTL's testing and inspection procedures.
4. Concrete finishes and finishing.
5. Cold- and hot-weather concreting procedures.
6. Curing procedures.
7. Concrete design mixture and examine procedures for ensuring quality of concrete materials.
8. Proposed sources of concrete materials, including capabilities and location of plant that will manufacture concrete.
9. Tour, inspect and discuss condition of subgrade, drainage structures, and other preparatory work.
10. Requirements for protecting concrete work, including restriction of traffic during installation period and for remainder of construction period.
11. Review and finalize construction schedule and verify availability of materials.
12. Concrete paving requirements (drawings, specifications and other contract documents).
13. Required submittals, both completed and yet to be completed.
14. Weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
15. Safety precautions relating to placement of concrete.
16. Changes to the contract documents from recommendations or discussions at the Pre-Construction meeting shall be approved in writing by the Wal-Mart Construction Manager prior to implementation.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Concreting in Hot, Dry, or Windy Weather:

1. Employ precautions to avoid cracking when the concrete rate of evaporation exceeds 0.1 pounds per square foot per hour or when any combination of concrete materials and weather conditions are favorable for the formation of plastic shrinkage cracks.
2. Maintain an accurate reading thermometer at the job site to check temperature of concrete.
3. Reject concrete if more than one slump adjustment, as defined in ASTM C 94, is required.
4. Do not place concrete when forms, subgrade, aggregate base, or reinforcing bars are more than 120 F or the temperature differential between the forms, aggregate base, or reinforcing bars and concrete will create conditions favorable for settlement cracks or thermal cracking.

B. Concreting in Cold Weather:

1. Conform to ACI 306.1 when temperature and other environmental conditions are as noted therein.
2. Subgrade shall be thawed to depth of 12 inches immediately before placing concrete.
3. Measure and record concrete temperature during protection period in each placement at regular time intervals, but not less than 3 times per 24 hour period.
4. Do not place slabs on subgrade or base that is more than 20°F cooler than concrete. Warm subgrade or base to decrease temperature differential to 20 F or less

1.6 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities (and Wal-Mart customers at expansion projects). Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.
- B. Aggregate Base and Choker Materials:
 1. Aggregate Base Material:

- a. Aggregate base should conform to Caltrans Class II Aggregate Base with maximum 3/8-inch nominal size.
- 2. Aggregate Choker Material: Clean granular fill with less than 3% clay and/or friable particles. Use one of the following gradations:
 - a. ASTM 448 No. 10 with 6% to 12% passing No. 200 sieve.
 - b. Material meeting the following gradation:

Std. Sieve Size	% Passing
No. 4	85-100
No. 8	75-95
No. 16	55-75
No. 50	22-45
No. 100	10-30
No. 200	6-12

C. Reinforcement:

- 1. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets.
- 2. Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60.
- 3. Joint Dowel Bars: ASTM A36, square plain steel bars, cut bars true to length with ends square and free of burrs.
 - a. PNA Systems (install per project detail and manufacturer's recommendations)
 - 1) PNA Diamond Dowel System: Tapered plate dowels with sleeves for formed construction joints.
 - 2) PNA PD3 Basket Assembly: Tapered plate dowels and dowel baskets for sawcut contraction joints.
 - 3) PNA Square Dowels: Square dowels with sleeves for construction joints to existing pavement.
 - b. Sika Greenstreak Systems (install per manufacturer's recommendations)
 - 1) Sika Greenstreak Speed Plate System: Square plate dowels with sleeves for formed construction joints.
 - 2) Sika Greenstreak Double Tapered Basket: Tapered plate dowels and dowel baskets for sawcut contraction joints.
 - 3) Sika Greenstreak Speed Dowel: Square dowels with sleeves for construction joints to existing pavement.
 - c. Equivalent alternate systems proposed by the Contractor shall be submitted to the CEC within 30 days after award of Contract. Any equivalent alternate shall only be used if approved in writing by the CEC.

D. Cementitious Materials:

- 1. Portland Cement: ASTM C150, Type I, Use only one brand throughout project.
- 2. Fly Ash: ASTM C 618, Class C or F. Use only one type and source throughout project.
- 3. Slag: ASTM C989, Grade 100 or 120. Use only one type and source throughout project.

E. Pavement Joint Materials:

- 1. Joint Back-up Material: Polyethylene foam, 100% closed cell
- 2. Soft Preformed Joint Filler: Flexible closed-cell non-extruding synthetic foam expansion joint strips.
 - a. Ceramar Flexibe Foam Expansion Joint, by W.R. Meadows.
 - b. Deck-O-Foam Expansion Joint Filler, by W.R. Meadows
- 3. Sealant:
 - a. Dow 888, by Dow Corning.
 - b. 301 NS by Pecora.
 - c. Spectrum 800 by Tremco.

F. Concrete Aggregate:

- 1. Conform to ASTM C33.
- 2. Aggregate shall contain no coal or lignite in concrete that will not be covered by soil.
- 3. Fine Aggregate:
 - a. Conform to fine aggregate grading requirements as defined in section 6.1 of ASTM C 33 unless approved by the Civil Engineer.

- b. If manufactured sand is used, blend with minimum 25% natural sand unless otherwise approved by Civil Engineer.
- 4. Coarse Aggregate:
 - a. Nominal maximum coarse aggregate size shall be 1 inch for slabs \leq 5-1/2 inch thick.
 - b. The nominal maximum size of an aggregate is the smallest sieve size through which the major portion of the aggregate must pass, with a minimal amount retained on the maximum sieve size. Maximum 4% shall be retained on the nominal maximum size sieve.
- 5. Adjust proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution characteristics, unless otherwise approved:
 - a. Coarseness Factor of 60 to 75%.
 - 1) The Coarseness Factor (CF) is the percent of combined aggregate retained on the #8 sieve that is also retained on the 3/8" sieve.
 - 2) The Coarseness Factor is calculated as follows:
 - a) $CF = \text{Aggregate retained on } 3/8'' \text{ sieve} / \text{Aggregate retained on } \#8 \text{ sieve.}$
 - b. Adjusted Workability Factor
 - 1) The Workability Factor (WF) is the percent of combined aggregate that passes the #8 sieve.
 - 2) The Adjusted Workability Factor (Adj-WF) is calculated as follows:
 - a) $\text{Adj-WF} = WF + [(\text{Cementitious Material} - 564 \text{ lbs.}) / 37.6]$
 - 3) The range of accepted Adj-WF for a given CF is as follows:
 - a) $\text{Adj-WF} = [(11.25 - .15 CF) + 33] \pm 2.5$
 - 4) Combined percent retained on any given sieve size shall not exceed 24%.
 - c. Gradation requirement of ASTM C33 may be waived in order to meet ranges specified.

G. Water: ASTM C 1602.

H. Air Entrainment: ASTM C260.

- 1. Air-Mix or AEA-92, by Euclid.
- 2. MasterAir VR 10, MasterAir AE 90, or MasterAir E 200 by BASF Admixtures.
- 3. Daravair or Darex Series, by W.R. Grace.
- 4. Equivalent approved products.

I. Evaporation Retardant: Water-based polymer, sprayable.

- 1. Euco-Bar, by Euclid
- 2. MasterKure ER 50 by BASF Admixtures
- 3. Aquafilm, by Dayton Superior.

J. Liquid Membrane Curing and Sealing Compound: ASTM C 1315, Type I, Class A or B, 25% minimum solids content, clear non-yellowing with no styrene-butadiene.

- 1. Water Based, VOC less than 350 g/l:
 - a. Super Aqua Cure, by Euclid Chemical Corp.
 - b. MasterKure CC 1315WB by BASF Admixtures.

K. Dissipating Curing Compound (For use below 40F): ASTM C 309 Type 1, Class A or B.

- 1. Solvent base, VOC less than 350 g/l: Cetri Vex EnvioCure 100 by Vexcon.

2.2 CONCRETE MIX

A. Design mix shall produce normal weight concrete consisting of Portland cement, supplementary cementitious materials, aggregates, admixtures, and water to produce specified requirements.

B. Geographical Weather Exposure Classification: Geographical exposure classification shall be [Negligible F0] exposure.

C. Concrete Site Pavement and Light Pole Bases

- 1. ACI Exposure Category and classification:
 - a. Negligible exposure: F0
- 2. Compressive Strength: Strength at 28 days, unless otherwise indicated on the Drawings:
 - a. Negligible exposure classification: 3,500 psi.
 - b. .

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3. Maximum Water-Cementitious Material Ratio (Cement Quantity Includes Fly Ash or slag):
 - a. Negligible exposure: 0.55 by wt.
4. Slump Range: Slump at the point of placement shall be 2 to 4 inches for hand placed concrete, 1-1/4 to 3 inches for machine placed (slip form) concrete. Maximum slump variance shall be 2 inches.
5. Air Content: As shown in the table below.

D. Air Entrainment as shown below:

E.

Nominal Maximum Size Aggregate (Inch)	Average Air Content (%) +/- 1.5% By Exposure Category	
	Negligible - F0	Moderate or Severe – F2 & F3
3/8	4.5	7.5
1/2	4.0	7.0
3/4	3.5	6.0
1	3.0	6.0
1-1/2	2.5	5.5

F. Supplementary Cementitious Materials (SCM):

1. Concrete mix shall contain SCM at the amounts specified unless other amounts are approved by the Civil Engineer. Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for the SCM but shall not be used together to form a ternary mix. Use of fly ash or GGBFS in the concrete mix is mandatory.
2. Fly Ash: Substitute fly ash for Portland cement at 20% of the total cementitious content.
 - a. If used to mitigate potential aggregate reactivity, up to 30% fly ash substitution of Portland cement is allowed. Only Type F fly ash may be used and shall have the following maximum properties: 1.5% available alkali and 8.0% CaO. When a maximum of 30% replacement is used, up to 10.0% CaO is permitted.
3. Ground Granulated Blast Furnace Slag (GGBFS): Substitute GGBFS for Portland cement at 25% of the total cementitious content.
 - a. If required to mitigate potential sulfate exposure or aggregate reactivity, up to 50% GGBFS substitution of Portland cement is allowed.
4. Maintain air-entrainment at specified levels.

G. Calcium Chloride:

1. Calcium chloride (Type L) may be used in solution form as part of the mixing water to accelerate concrete setting and early-strength development.
2. Amount of calcium chloride added shall not be more than necessary to produce the desired results and shall not exceed 2% by weight of cement.
3. The dosage range for the calcium chloride for the entire project shall not vary by more than 1%. Range is defined as the difference between the maximum and minimum dosages of calcium chloride for the entire project.
4. Calcium chloride shall not be used in the following applications unless approved by the Civil Engineer:
 - a. concrete containing embedded dissimilar metals or aluminum
 - b. slabs supported on permanent galvanized steel forms
 - c. concrete exposed to deicing chemicals
 - d. prestressed or post-tension concrete
 - e. concrete containing aggregates with potentially deleterious reactivity and concrete exposed to soil
 - f. concrete exposed to soil or water containing sulfates.
5. Use calcium chloride in accordance with manufacturer's recommendation.
6. Chloride-ion Concentration: Maximum water-soluble chloride-ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the following limits unless approved by the Civil Engineer:

Type of Member	Maximum water-soluble chloride ion (Cl-) content in concrete (percent by weight of cement)

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Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	0.30

7. When using calcium chloride or other admixtures containing chlorides, measure water-soluble chloride-ion content (percent by weight of cement) per ASTM C 1218. Sample shall be from concrete representing the submitted mix design and maximum chloride dosage anticipated for the project.

2.3 MIXING

- A. Mix concrete and deliver in accordance with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Proofroll prepared base material surface to check for unstable areas in accordance with Section 02300 including documentation and re-proof rolling as required. Paving work shall begin only after unsuitable areas have been corrected and are ready to receive paving.
- B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.2 AGGREGATE BASE PLACEMENT

- A. Unless otherwise specified on the Drawings, place aggregate base as specified herein.
- B. Aggregate Base:
 1. Install aggregate base where shown on Drawings.
 2. Compact to final thickness shown in layers not exceeding 6 inches with minimum of 2 passes per layer with vibratory compactor.
 3. Compact fill to 95% of aggregate's Standard Proctor as determined by Method D of ASTM D1557.
 4. Leave base up to 2 inches low until just prior to concrete placement.
- C. Aggregate Base Fine Grading:
 1. Compact to final thickness shown with 2 passes minimum vibratory compactor to produce smooth, flat, dense surface.
 2. Do not allow excess moisture in or on base at time of placing concrete.
 3. Level off aggregate base top surface with a maximum 3/4" thick aggregate choker material to achieve the following:
 - a. To reduce surface friction and to meet specified fine grade tolerances specified below.
 - b. To level areas exposed to rain, traffic, or excavations for buried utilities.
 - c. At areas where aggregate base material does not have sufficient fine particles to produce a surface that is free of exposed aggregate or surface voids greater than 3/8" in size at time of slab installation.
 4. Wal-Mart Construction Testing Laboratory shall verify adequate fines at surface immediately prior to concrete slab placement.
 5. Provide dry, smooth, flat, dense surface
 6. Proof-roll 48 hrs. maximum prior to concrete placement. Depression under a fully loaded ready mix truck shall not exceed 1/2 inch.
- D. Pavement Aggregate Base Fine Grade Tolerance: +0 inch, -3/4 inch with transition no greater than 3/4 inch vertically to 8 inches horizontally.

3.3 INSTALLATION

- A. Form Construction

1. Set forms to required grades and lines, rigidly braced and secured.
 2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
 3. Check completed formwork for grade and alignment to following tolerances:
 - a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
 4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Reinforcement: Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.
- C. Concrete Placement
1. Mix and place concrete when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F and rising. Hot and cold weather concreting shall be in accordance with ACI 305.1 (hot weather) and 306.1 (cold weather).
 2. Do not place concrete until base material and forms have been checked for alignment and grade. Concrete shall not be placed around manholes or other structures until they are at required finish elevation and alignment.
 3. Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
 4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint.
- D. Contraction and Construction Joints: Construct contraction and construction joints straight with face perpendicular to concrete surface. Construct transverse joints perpendicular to centerline, unless otherwise detailed.
1. Contraction Joints: Provide joints at spacing of 12'-0" on centers, maximum each way. Construct control joints for depth equal to at least 1/4 of the concrete thickness, as follows:
 - a. Form tooled joints in fresh concrete by grooving top with recommended tool and finishing edge with jointer.
 - b. Sawed Contraction Joints:
 - 1) Use saws, blades, skid plates, and accessories by Soff-Cut International, Inc. or approved equal.
 - 2) Start cutting sawed joints as soon as concrete has hardened sufficiently to prevent raveling or dislodging of aggregates. This will typically be from 1 hour in hot weather to 4 hours in cold weather after completing finishing of slab in that joint location.
 - 3) Provide at least two "Soff-Cut" saws on site with blades capable of achieving the required depth of saw cut.
 - 4) Extend sawed joint to the slab boundaries and abutments, including columns, drains, and other penetrations in the path of a defined joint. Implement methods and timing of the saw cut beyond the limits of the Soff-Cut saw reach to provide a consistent depth of cut with minimal raveling of joint edges.
 2. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour. Construct joints in accordance with details shown.
- E. Isolation and Fixed Object Joints: Construct joint at locations and in accordance with details shown.
- F. Pavement Joint Materials: Place joint fillers, back-up material, and sealants at locations shown and in accordance with manufacturer's instructions.
1. Soft Preformed Joint Fillers: Extend preformed joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface. Furnish preformed joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip preformed joint filler sections together in a single plane.

3.4 CONCRETE FINISHING

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- A. After initial striking off and consolidating of concrete paving, smooth surface using either magnesium straight edge, wood, or magnesium channel float.
- B. Round edges of slabs and formed joints to 1/2-inch radius with edging tool. Eliminate tool marks on concrete surface.
- C. After completion of straightedge / floating and when excess moisture or surface sheen has disappeared, uniformly finish surface to provide a coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to flow of traffic so as to produce regular corrugations not over 1/16 of an inch deep. Initial nonslip finishing shall be approved by the Wal-Mart Construction Manager.
- D. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Owner.

3.5 CURING AND PROTECTION

- A. Protect and cure finished concrete paving using curing compound. Cure for a period not less than 7 days.
- B. Use solvent based curing compound when compound is applied below 40 F.

3.6 CLEANING AND ADJUSTING

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.7 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. Responsibilities and Duties Relative to Owner Testing and Inspection:
 1. Notify Owner's CTL in advance of concrete placements to allow sufficient time to prepare for a site visit.
 2. Assist Owner's agency in securing field specimens.
 3. Provide and maintain for sole use of CTL, facilities for safe storage and proper curing of concrete test cylinders at project site as required by ASTM C31 and acceptable to Wal-Mart Testing Laboratory.
- C. Correction of Deficient Work:
 1. When directed by the Owner, remove and replace or repair concrete and related Work which does not conform to specified requirements including strength, tolerances, and finishes.
 2. Bear cost of corrections or delays to other work affected by, or resulting from, corrections to concrete Work.
 3. If results of compressive strength tests reveal deficiencies in concrete, meet requirements of ACI 318 and ACI 301.

PART 4 - OWNER TESTING AND INSPECTION (T&I) AND OBSERVATION

- A. The Owner will perform testing and inspection (T & I) as specified in Appendix B (Section 02751).
- B. Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

WAL-MART STORES
CONCRETE MIX DESIGN SUBMITTAL FORM

(Section 02751 – Concrete Pavement)

Date

DISCOUNT STORE SUPERCENTER NEIGHBORHOOD MARKET SAM'S CLUB

STORE INFORMATION

STORE #	4091-500
ADDRESS	
CITY, ST	STOCKTON, CA
GENERAL CONTRACTOR	
COMPANY	
JOBSITE PHONE	

A. CONCRETE INFORMATION

Supplier Mix Design #	
Design Strength (f'c)	psi
Water / Cementitious Ratio	
Total Air Content	%
Total Est. Volume of Concrete	CY
Mix Developed From:	
<input type="checkbox"/> Trial Mix Test Data (<i>attach test data</i>)	
<input type="checkbox"/> Field Experience	
Density	
Wet	pcf
Dry	pcf
Slump	
“	(± 1”) WITHOUT WR Admixture
“	(± 1”) WITH WR Admixture

LEAVE BLANK FOR STAMP OF APPROVAL BY
CONCRETE SUPPLIER AND ENGINEER OF RECORD

B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces)	
			oz / cy	oz / cwt
Water Reducing				
Accelerating				
Retarding				
Air-Entraining				

C. MIX DESIGN

Mix Proportions (per cubic yard)

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	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	Volume (cubic feet)	% Aggregate Absorption
	Cement				
	Fly Ash				
	Slag				
	Coarse Aggregate #1				
	#2				
	#3				
	Fine Aggregate #1				
	#2				
	Water				
	Air Content				
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	% Passing Each Sieve (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2		Cumulative	Individual
1-1/2"								
1"								
3/4"								
1/2"								
3/8"								
# 4								
# 8								
# 16								
# 30								
# 50								
# 100								
# 200								
% of Vol								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained } 3/8'' \text{ sieve}}{\text{Combined \% cumulative retained } \#8 \text{ sieve}}$	=		
Workability Factor =	Combined % passing #8 sieve	=		
Adj-Workability Factor =	$WF + [(Cementitious \text{ Material} - 564) \div 37.6]$	=		
Allowable Adj-WF=	$Adj-WF = [(11.25 - .15 \text{ CF}) + 33] \pm 2.5$	=	Low	High

D. **ATTACHMENTS:** Include the following with this Mix Design Report.

- Portland Cement mill test reports
- Fly ash mill test reports
- Slag mill test reports
- Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials
- Separate aggregate gradation reports including all required sieve sizes
 - All gradation sieve report tests dated within 60 days of this report
 - Report for each coarse and fine aggregate material in mix
- Statement if possible reactivity of aggregate, based on tests or past service
- Statement if possible aggregate pop-outs or their disruptions, based on tests or past service
- Product data for the following admixtures:
 - Chloride ion data and related calculations
 - Water reducing, set retarding, set accelerating, etc.
- Measured water-soluble chloride ion content in concrete (percent by weight of cement).
- Concrete compressive strength data used for standard deviation calculations

E. **CONCRETE SUPPLIER INFORMATION**

Company Name	_____	Tel. #	_____ () _____
Address	_____		
City, ST Zip	_____		
Technical Contact	_____	Cell #	_____ () _____
		e-mail	_____
Sales Contact	_____	Cell #	_____ () _____
	<u>PRIMARY PLANT</u>		<u>SECONDARY PLANT</u>
Plant Location:	_____		_____
Miles from Site:	_____		_____
Travel Time to Site:	_____		_____
NRMCA Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO
State DOT Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO		<input type="checkbox"/> YES <input type="checkbox"/> NO
Batch Mixing Type:	<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX		<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX

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SECTION 02770 (32 1600) - CURBS AND SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - Portland cement concrete curbs, gutters, and sidewalks except sidewalks adjacent to building.
- B. Related Requirements:
 - Section 02300 - Earthwork: Preparation of subgrades.
 - Section 03310 - Structural Concrete and Exterior Concrete Slabs: Exterior sidewalks adjacent to building.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Concrete Institute (ACI):
 - ACI 305R - Hot Weather Concreting
 - ACI 306R - Cold Weather Concreting
 - ACI 306.1 - Cold Weather Concreting.
 - ACI 308 - Curing Concrete
- C. ASTM International (ASTM):
 - ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
 - ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
 - ASTM C39 - Comprehensive Strength of Cylindrical Concrete Specimens.
 - ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - ASTM C94 - Ready-Mixed Concrete.
 - ASTM C138 - Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - ASTM C143 - Slump of Hydraulic Cement Concrete.
 - ASTM C231 - Air-Content of Freshly Mixed Concrete by the Pressure Method.
 - ASTM C172 - Sampling Freshly Mixed Concrete.
 - ASTM C173 - Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - ASTM C260 - Air-Entraining Admixtures for Concrete.
 - ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
 - ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
 - ASTM C1064 - Temperature of Freshly Mixed Portland Concrete Cement.
 - ASTM C1218 - Water-Soluble Chloride in Mortar and Concrete.
 - ASTM D98 - Calcium Chloride.
 - ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous).
 - ASTM D1190 - Concrete Joint Sealer, Hot Poured, Elastic Type.
 - ASTM D1751 - Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- D. Federal Specifications (FS):
 - FS HH-F-341 - Fillers, Expansion Joint: Bituminous (Asphalt & Tar)
- E. State of California Department of Transportation (CALTRANS):
 - 2018 Standard Specifications
- F. City of Stockton Standard Specifications

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1.3 SUBMITTALS

A. Mix Design:

Fill out and submit attached Concrete Mix Design Submittal Form.

Submit three copies of each proposed mix.

Submit separate mix design for concrete to be placed by pumping in addition to the mix design for concrete to be placed directly from the truck chute.

Submit mix design to the Civil Engineering Consultant of Record, the Owner's Construction Testing Laboratory, and the Owner's Assigned Concrete Sub-Consultant.

Include applicable information shown on the Mix Design Submittal Form and the following:

- a. Proportions of cementitious materials, fine and coarse aggregate, and water.
- b. Water-cementitious material ratio, 28-day compressive design strength, slump, and air content.
- c. Type of cement, fly ash, slag and aggregate.
- d. Aggregate gradation.
- e. Type and dosage of admixtures.
- f. Special requirements for pumping.
- g. Range of ambient temperature and humidity for which design is valid.
- h. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
- i. Materials and methods for curing concrete.

B. Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Engineering Consultant of Record and the Construction Testing Laboratory for review and approval and within 7 calendar days after receipt of Notice-to-Proceed.

Concrete mix design(s)

Type and source of Portland cement, fly ash, and slag

Aggregate gradations

Preformed expansion joint filler

Field molded/poured sealant

Dowel bars

Expansion sleeves

Tie bars

Reinforcing steel bars

Welded wire fabric

Air entraining admixtures

Water-reducing, set-retarding and set-accelerating admixtures (if used)

C. Test Reports: Submit field quality control test reports.

1.4 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Forms shall be of depth equal to depth of curbing or sidewalk, and so designed as to permit secure fastening together at tops. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.

B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets.

C. Reinforcing Steel: Deformed steel bars, ASTM A615, Grade 60.

D. Portland Cement: Shall conform to ASTM C150, Type I.

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- E. Fly Ash: ASTM C618, Class C or F. Use only one type and source throughout project.
- F. Slag: ASTM C989, Grade 100 or 120. Use only one type and source throughout project.
- G. Exterior Pavement Joint Materials
 - Joint Back-up Material: Polyethylene foam, 100% closed cell.
 - Sealant:
 - a. Dow 888, by Dow Corning.
 - b. 301 NS by Pecora.
 - c. Spectrum 800 or 900 by Tremco.
- H. Aggregate: ASTM C33.
- I. Water: Clean and potable
- J. Dowel Bars: ASTM A615, grade 60, and plain steel bars.
- K. Air Entrainment: ASTM C260. .
 - Air-Mix or AEA-92, by Euclid Chemical Corp.
 - MasterAir VR 10, MasterAir AE 90, or MasterAir E 200 by BASF Admixtures.
 - Daravair or Darex Series, by W.R. Grace.
 - Equivalent approved products.
- L. Liquid Membrane Curing and Sealing Compound: ASTM C1315, Type I, Class A or B, 25% minimum solids content, clear non-yellowing with no styrene-butadiene.
 - Water Based, VOC less than 350 g/l:
 - a. Super Aqua Cure, by Euclid Chemical Corp.
 - b. MasterKure CC 1315WB by BASF Admixtures.
- M. Dissipating Curing Compound: ASTM C309 Type 1, Class A or B.
 - Solvent base, VOC less than 350 g/l: Cetri Vex EnvioCure 100 by Vexcon.

2.2 CONCRETE MIXING

- A. Mix concrete and deliver in accordance with ASTM C94. Design mix shall produce normal weight concrete consisting of Portland cement, supplementary cementitious materials, aggregates, admixtures and water to produce the following:
 - Compressive Strength: 3,500 psi minimum at 28 days unless otherwise indicated on the Drawings.
 - Slump Range: 2"-4" for hand placed concrete, 1-1/4" to 3" for machine placed (slipform) concrete.
 - Air Entrainment: 5 to 8 percent.
- B. Supplementary Cementitious Materials (SCM):
 - Concrete mix shall contain SCM at the amounts specified unless other amounts are approved by the Civil Engineer. Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for the SCM but shall not be used together to form a ternary mix. Use of fly ash or GGBFS in the concrete mix is mandatory.
 - Fly Ash: Substitute fly ash for Portland cement at 15% of the total cementitious content.
 - a. If used to mitigate potential aggregate reactivity, only Type F fly ash may be used and shall have the following maximum properties: 1.5% available alkali and 8.0% CaO. When a maximum of 25% replacement is used, up to 10.0% CaO is permitted.
 - Ground Granulated Blast Furnace Slag (GGBFS): Substitute GGBFS for Portland cement at 20% of the total cementitious content.
 - b. If required to mitigate potential sulfate exposure or aggregate reactivity, up to 50% substitution of Portland cement is allowed.
 - Maintain air-entrainment at specified levels.
- C. Calcium chloride:
 - Calcium chloride (Type L) may be used in solution form as part of the mixing water to accelerate concrete setting and early-strength development.
 - a. Amount of calcium chloride added shall not be more than necessary to produce the desired results and shall not exceed 2% by weight of cement.

- b. The dosage range for the calcium chloride for the entire project shall not vary by more than 1%. Range is defined as the difference between the maximum and minimum dosages of calcium chloride for the entire project.
- c. Calcium chloride shall not be used in the following applications unless approved by the Civil Engineer:
 - 1) concrete containing embedded dissimilar metals or aluminum
 - 2) slabs supported on permanent galvanized steel forms
 - 3) concrete exposed to deicing chemicals
 - 4) prestressed or post-tension concrete
 - 5) concrete containing aggregates with potentially deleterious reactivity and concrete exposed to soil
 - 6) concrete exposed to soil or water containing sulfates.

Use calcium chloride in accordance with manufacturer's recommendation.

Chloride-ion Concentration:

- d. Maximum water-soluble chloride-ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious material, and admixtures shall not exceed the following limits unless approved by the Civil Engineer:

Type of Member	Maximum water-soluble chloride ion (Cl-) content in concrete (percent by weight of cement)
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	0.30

When using calcium chloride or other admixtures containing chlorides, measure water-soluble chloride-ion content (percent by weight of cementitious materials) per ASTM C1218. Sample shall be from concrete representing the submitted mix design and maximum chloride dosage anticipated for the project.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Begin paving work only after unsuitable areas have been corrected and are ready to receive paving.
- B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.2 INSTALLATION

- A. Form Construction
 - Set forms to required grades and lines, rigidly braced and secured.
 - Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
 - Check completed formwork for grade and alignment to following tolerances:
 - a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
 - Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.
- B. Reinforcement: Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.
- C. Concrete Placement

Concrete shall be mixed and placed when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F and rising. Hot and cold weather concreting shall be in accordance with ACI 305R (hot weather) and 306.1 and 306R (cold weather). Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until set at required finish elevation and alignment.

Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be used for curb and gutter placement. Machine placement shall be at required cross section, line, grade, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified herein.

D. Joint Construction

Contraction Joints: Construct concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, in uniform sections of approximately 10 feet in length. Form joints between sections either by steel templates, 1/8-inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2-inches below surface of curb and gutter; or with 3/4-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least 2-inches while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold its shape, but shall be removed while forms are still in place. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, to concrete pavement with 1/2-inch round deformed reinforcement bars 2 feet in length and 5 feet on center.

E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together. Transverse

F. Joint Sealants: Install in accordance with manufacturer's recommendations.

3.3 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.

B. Work edges of sidewalks, gutters, back top edge of curb, and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and trowelling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

Curbs, gutters, and sidewalks: Broom finish by drawing fine-hair broom across surface perpendicular to flow of traffic. Repeat operation as necessary to produce fine line texture.

C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects as directed Owner.

D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable work as directed by Owner.

3.4 CURING AND PROTECTION

A. Protect and cure finished concrete paving using with curing compound or with acceptable moist-curing methods in accordance with "water-curing" section of ACI 308. Cure for a period not less than 7 days.

B. Use solvent based curing compound when compound is applied below 40 F.

3.5 BACKFILL

- A. After concrete has set sufficiently, spaces on either side of concrete curb, combination concrete curb and gutter, or concrete sidewalk shall be refilled to required elevation with suitable material compacted in accordance with Section 02300.

3.6 CLEANING AND PROTECTION

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.7 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements.

END OF SECTION

WAL-MART STORES
 CONCRETE MIX DESIGN SUBMITTAL FORM
 (Section 02770 – Concrete Pavement)

Date

DISCOUNT STORE SUPERCENTER NEIGHBORHOOD MARKET SAM'S CLUB

STORE INFORMATION

STORE # _____
 ADDRESS _____
 CITY, ST _____
 GENERAL CONTRACTOR _____
 COMPANY _____
 JOBSITE PHONE _____

A. CONCRETE INFORMATION

Supplier Mix Design #	_____
Design Strength (f'c)	_____ psi
Water / Cementitious Ratio	_____
Total Air Content	_____ %
Total Est. Volume of Concrete	_____ CY
Mix Developed From:	
<input type="checkbox"/> Trial Mix Test Data (<i>attach test data</i>)	
<input type="checkbox"/> Field Experience	
Density	
Wet _____ pcf	Dry _____ pcf
Slump	
“ _____ (± 1”) WITHOUT WR Admixture	
“ _____ (± 1”) WITH WR Admixture	

LEAVE BLANK FOR ENGINEER'S STAMP

B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces)	
			oz / cy	oz / cwt
Water Reducing				
Accelerating				
Retarding				

C. MIX DESIGN

Mix Proportions (per cubic yard)

	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	Volume (cubic feet)	% Aggregate Absorption
Cement					
Fly Ash					
Slag					
Coarse Aggregate #1					
#2					
#3					
Fine Aggregate #1					
#2					
Water					
Air Content					
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	% Passing Each Sieve (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2		Cumulative	Individual
1-1/2"								
1"								
3/4"								
1/2"								
3/8"								
# 4								
# 8								
# 16								
# 30								
# 50								
# 100								
# 200								
% of Vol								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained } 3/8'' \text{ sieve}}{\text{Combined \% cumulative retained } \#8 \text{ sieve}}$	=	
Workability Factor =	Combined % passing #8 sieve	=	
Adj-Workability Factor =	$WF + [(Cementitious \text{ Material} - 564) \div 37.6]$	=	
Allowable Adj-WF=	$Adj-WF = [(11.25 - .15 \text{ CF}) + 34.5] \pm 2.5$	=	Low High

D. ATTACHMENTS: Include the following with this Mix Design Report.

- Portland Cement mill test reports
- Fly ash mill test reports
- Slag mill test reports

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Stockton, CA – Store #4091-500

08/04/22

- Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials
- Separate aggregate gradation reports including all required sieve sizes
 - All gradation sieve report tests dated within 60 days of this report
 - Report for each coarse and fine aggregate material in mix
- Statement if possible reactivity of aggregate, based on tests or past service
- Statement if possible aggregate pop-outs or their disruptions, based on tests or past service
- Product data for the following admixtures:
 - Chloride ion data and related calculations
 - Water reducing, set retarding, set accelerating, etc.
- Measured water-soluble chloride ion content in concrete (percent by weight of cement)
- Concrete compressive strength data used for standard deviation calculations

E. CONCRETE SUPPLIER INFORMATION

Company Name		Tel. #	()
Address			
City, ST Zip			
Technical Contact		Cell #	()
		e-mail	
Sales Contact		Cell #	()

	PRIMARY PLANT	SECONDARY PLANT
Plant Location:		
Miles from Site:		
Travel Time to Site:		
NRMCA Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
State DOT Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
Batch Mixing Type:	<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX	<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX

SECTION 02765 (32 1723) - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Painting and marking of pavements, curbs, guard posts, and light pole bases.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Association of State Highway and Transportation (AASHTO):

1. AASHTO M247 - Glass Beads Used in Traffic Paints
2. AASHTO M248 - Ready-Mixed White and Yellow Traffic Paints

C. Master Painter's Institute (MPI):

1. MPI 32 – Traffic Marking Paint, Solvent Based.
2. MPI 97 – Traffic Marking Paint, Latex.

D. ASTM International (ASTM):

1. ASTM D4259 – Standard Practice for Abrading Concrete.
2. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness by Notched Gauges.

E. Federal Specifications (FS):

1. FS A-A-2886 - Paint, Traffic, Solvent Based (supersedes FS TT-P-85 and FS TT-P-115, Type I)
2. FS TT-B-1325 - Beads (Glass Spheres) Retro-Reflective
3. FS TT-P-1952 - Paint, Traffic And Airfield Marking, Waterborne

F. The Society for Protective Coatings (SSPC):

1. SSPC-SP13 – Surface Preparation of Concrete.

G. State of California Department of Transportation (CALTRANS):

1. 2018 Standard Specifications

H. City of Stockton Standard Specifications

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust.

- B. Dispose of construction waste in accordance with the requirements of Section 01351 Regulatory Compliance Supplement.

1.4 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement marking and striping material shall be thermoplastic paint conforming to Section 84-2, "Thermoplastic Traffic Stripes and Pavement Markings" of the CALTRANS 2018 Standard Specifications shall be used as the standard construction material for all pavement markings.
- B. Paint shall be waterborne or solvent borne, colors as shown or specified herein. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.
- C. Waterborne Paint: Paints shall conform to FS TT-P-1952 and have MPI 97 approval.
- D. Solvent Borne Paint: Paint shall conform to FS A-A-2886 or AASHTO M248 and have MPI 32 approval. Paint shall be non-bleeding, quick-drying, and alkyd petroleum base paint suitable for traffic-bearing surface and be mixed in accordance with manufacturer's instructions before application for colors White, Yellow, Blue, and Red.
- E. Glass Beads: AASHTO M 247, Type 1 or FS TT-B-1325, Type 1, Gradation A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the work area and correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust.
- B. Where existing pavement markings are indicated on Construction Drawings to be removed or would interfere with adhesion of new paint, sodium bicarbonate (soda) blasting shall be used to remove the markings. Equipment employed shall not damage existing paving or create surfaces hazardous to vehicle or pedestrian traffic and shall be equipped with a manufacturer's recommended mist system for dust suppression. Within public rights-of-way, appropriate governing authority shall approve method of marking removal.
- C. New pavement surfaces shall be allowed to cure for not less than 30 days before application of marking materials.

3.3 APPLICATION

- A. Apply two coats of same color of paint as specified below, at manufacturer's recommended rate, without addition of thinner, with maximum of 100 square feet per gallon or as required to provide a minimum wet film thickness of 15 mils and dry film thickness of 7 ½ mils per coat. Paint shall be applied for a total dry film thickness of 15 mils. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use straightedge to ensure uniform, clean, and straight stripe.
- B. Install pavement markings according to manufacturer's recommended procedures for the specified material.
- C. Following items shall be painted with colors noted below:
 - 1. Pedestrian Crosswalks: White
 - 2. Exterior Sidewalk Curbs and Guard posts: Yellow
- D. Apply glass beads at pedestrian crosswalk striping and at lane striping and arrows at driveways connecting to public streets. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.4 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with Section 01452. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements.

3.5 CLEANING

- A. Waste materials shall be removed at the end of each workday. Upon completion of the work, all containers and debris shall be removed from the site. Paint spots upon adjacent surfaces shall be carefully removed by approved procedures that will not damage the surfaces and the entire job left clean and acceptable.

END OF SECTION

REVISION NOTES:

Rev 1: (10/01/13) Minor revision for QA/QC consistency. (CI 11724) (CI 12673)

SECTION 02822 (32 3114) - CHAIN LINK FENCES AND GATES (SITE RELATED)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chain link fences and gates associated with sitework.

B. Related Requirements:

1. Section 02821 – Chain Link Fences and Gates (Building Related): Fences and gates within or adjacent to building.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A 392 - Zinc-Coated Steel Chain-Link Fence Fabric
2. ASTM C 94 - Ready-Mixed Concrete

B. Chain Link Fence Manufacturers Institute (CLFMI) latest edition Product Manual

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Posts: Type I or II or roll formed "C" Section steel conforming to CLFMI and as specified hereinafter.

- B. Fabric: No. 9 gage (0.148 nominal) galvanized steel wire in 2 inch mesh; ASTM A 392, top and bottom selvages twisted and barbed, height as shown. Furnish 1-piece fabric widths.

C. End, Corner, and Pull Posts: Minimum sizes and weights as follows:

1. Up to 13 Foot Fabric Height: Type I or II in accordance with CLFMI Product Manual.
2. 13 foot and over Fabric Height (If required):
 - a. Type I Posts: Round; 4.0 inch outside diameter pipe, 9.10 lbs/lin ft.
 - b. Type II Posts: 4.0 inch outside diameter pipe, 6.56 lbs/lin ft.

D. Line (Intermediate) Posts: Minimum sizes and weights as follows:

1. Up to 8 Foot Fabric Height: Type I, II, or "C" Section in accordance with CLFMI Product Manual.
2. Over 8 Foot Fabric Height:
 - a. Type I Posts:
 - 1) Round: 2.875 inch outside diameter pipe, 5.79 lbs/lin ft.
 - 2) Square: 2.5" x 2.5" outside dimension, 5.10 lbs/lin ft.
 - b. Type II Posts: 2.875 inch outside diameter pipe, 4.64 lbs/lin ft.

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- E. Gate Posts: Type I or II in accordance with CLFMI Product Manual.
- F. Top, Bottom, and Intermediate Rails: Type I or II in accordance with CLFMI Product Manual.
 - 1. Manufacturer's longest lengths.
 - 2. Couplings: Expansion type, approximately 6 inches long.
 - 3. Attaching Devices: Means of attaching top rail securely to each gate, corner, pull, and end post.
- G. Sleeves: Galvanized steel pipe not less than 6-inches long with inside diameter not less than ½ inch greater than outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve of width and length not less than 1 inch greater than outside diameter of sleeve.
- H. Tension Wire: 7 gage galvanized steel conforming to CLFMI, Marcellled, located at bottom of fabric.
- I. Wire Ties: Class 1 galvanized steel, no less than 9 gage.
- J. Post Brace Assembly: Manufacturer's standard adjustable brace at end of gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375-inch diameter rod and adjustable tightener.
- K. Post Tops: Galvanized steel, weather tight closure cap for each tubular post. Furnish caps with openings to permit passage of top rail.
- L. Stretcher Bars: Galvanized steel, 1 piece lengths equal to full height of fabric, with minimum cross-section of 3/16-inch x 3/4-inch. Provide one stretch bar for each gate and end post, and two for each corner and pull post.
- M. Stretch Bar Bands: Manufacturer's standard
- N. Gate Cross-bracing: 3/8-inch diameter galvanized steel adjustable length truss rods.
- O. Ready Mix Concrete: ASTM C94, mix design as follows:
 - 1. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - a. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.
 - b. Slump Range: 1 to 3 inches at time of placement
 - c. Air Entrainment: 5 to 8 percent
- P. Swinging Gate Hardware:
 - 1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit full 180-degree gate opening. Provide a pair of 1 1/2-inch hinges for each leaf over 6'-0" nominal height.
 - 2. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- Q. Double Gates Hardware: Provide gate stops for double gates, consisting of mushroom type of flush plate with anchors set in concrete, to engage center drop rod or plunger bar. Include locking device and padlock eye as integral part of latch, using 1 padlock for locking both gate leaves.
- R. Sliding Gate Hardware: Provide manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.

2.2 GATE FABRICATION

- A. Fabricate swing gate perimeter frames of 1.90-inch OD pipe, galvanized steel. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8'-0" apart.

- B. Assemble gate frames by welding or special fittings and rivets, for rigid connections. Install same fabric as for fence with stretcher bars at vertical edges. Install diagonal cross-bracing on gates as required ensuring rigid frame without sag or twist. Bars may be used at top and bottom edges. Attach stretchers to gate frame at 15 inches o.c. maximum.
- C. Attach hardware to provide security against removal or breakage.

2.3 FINISH

- A. Fabric, Framing, and Other Iron Parts: Hot dip zinc coated in accordance with CLFMI Product Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install chain link fence in accordance with CLFMI Product Manual unless otherwise specified herein.
- B. Comply with recommended procedures and instructions of fencing manufacturer. Provide secure, aligned installation with line posts spaced at 10'-0" o.c. maximum.
- C. Methods for Setting Posts:
 - 1. Grade-Set Posts:
 - a. Drill or hand excavate to a depth approximately 3 inches lower than post bottom. Set post bottom not less than 36 inches below finish grade.
 - b. Excavate each post hole to 12 inch diameter, or not less than four times diameter of post.
 - c. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Extend concrete footing 2-inches above grade and trowel crown to shed water.
 - d. Post shall be set plumb within 1/4" in 10 feet.
 - 2. Sleeve Set Posts: Anchor posts by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with nonshrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.
- D. Top Rails: Run rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- E. Center Rails: Provide center rails where indicated. Install in 1 piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- F. Brace Assemblies: Install braces so posts are plumb when diagonal rod are under proper tension.
- G. Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 gauge galvanized wire. Fasten fabric to tension wire using 11 gauge galvanized steel hog rings spaced 24-inches o.c.
- H. Fabric: Leave approximately 2 inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- I. Stretcher Bars: Secure at end, corner, pull, and gate posts by threading through or clamping to fabric at 4 inches o.c. and secure to posts with metal bands spaced at 15 inches o.c.
- J. Tie Wires:
 - 1. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly when ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - 2. Tie fabric to line posts with wire ties spaced 12 inches o.c. Tie fabric to rails and braces with wire ties spaced 24 inches o.c. Tie fabric to tension wires with hog rings spaced 24-inches o.c.

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3. Manufacturer's standard procedure will be accepted if of equal strength and durability.

K. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

L. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubrication.

3.2 ADDITIONAL INSTALLATION PROVISIONS

A. Use U-shape tie wires, conforming to the diameters of pipe, that clasp the pipe and fabric firmly with ends twisted at least 2 full turns.

B. Bend ends of exposed wires to minimize hazards to persons or clothing.

C. Install nuts for fasteners on tension bands and hardware bolts on the side of the fence opposite the fabric. The ends of bolts, once secure and checked for smooth operation, shall be peened to prevent removal of nuts.

D. Repair coatings damaged in the field with methods and techniques as recommended by the manufacturer.

END OF SECTION

SECTION 32 84 00

LANDSCAPE IRRIGATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Irrigation system required for this work includes but is not limited to the furnishing of all labor, tools, materials, appliances, tests, permits, taxes, etc., necessary for the installation of a landscape irrigation system as herein specified and shown on the drawings, and the removal of all debris from the site.
 - 1. Furnish and install all materials and equipment for a fully operational automatic irrigation system.
 - 2. Trenching, boring or drilling for all lines, backfilling and repair of all damage.
 - 3. Testing and startup of the irrigation system.
 - 4. Clean up and disposal of all excess and surplus material.
 - 5. Prepare as-built drawings and furnish all turnover materials.
 - 6. Maintenance of the irrigation system during the proscribed maintenance period.
- B. The system shall efficiently and evenly irrigate all areas and be complete in every respect and shall be left ready for operation to the satisfaction of the Owner's Representative.
- C. Coordinate with other trades as needed to complete work, including but not limited sleeves under paving and elsewhere, water and electrical Points of Connection (POC), equipment, and equipment pads.

1.02 RELATED DOCUMENTS

- A. Construction drawings and these specifications are a part of the contract documents. Refer to contract for a complete list of all contract documents. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.03 REFERENCE STANDARDS

- A. American Society of Testing Materials (ASTM): cited section numbers.
- B. National Sanitation Foundation (NSF): rating system.
- C. American Society of Agricultural and Biological Engineers (ASABE) ICC 802, latest edition.

1.04 VERIFICATION

- A. Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the Owner's Representative of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and or irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The Contractor shall be responsible to install the work in conformance to site conditions, complete, and in good working order.
- B. Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1.05 PERMITS AND REGULATIONS

- A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all applicable laws and ordinances.

- B. Wherever references are made to standards or codes in accordance with which the work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.
- C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply unless determined otherwise by the Owner's Representative.

1.06 PROTECTION OF WORK, PROPERTY, AND PERSONS

- A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to the Contractor's actions.

1.07 CORRECTION OF WORK

- A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work, and seasonal weather demands, but not more than 90 (ninety) days after notification.

1.08 DEFINITIONS

- A. Owner's Representative: The person appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.
- B. Substantial Completion: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner's Representative accepts that all work in these sections is complete, and the Warranty period has begun. This date may be different than the date of substantial completion for the other sections of the project.
- C. Final Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of specification. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

1.09 SUBMITTALS

- A. Comply with general conditions, special conditions, Division 1 sections and other contract documents. All submittals shall be made at least 4 weeks prior to delivery of materials.
- B. Product data
 1. Submit list of all irrigation equipment to be used, including specification (cut) sheets, within 15 days after the notice to proceed. This submission may be done digitally, and all documents shall be submitted in one PDF document.
 2. The submittals shall be packaged and presented in an organized manner, in the quantity described in Division 1 of the specifications. Provide a table of contents of all submitted items.
 3. Clearly identify on each submitted sheet by underlining or highlighting (on each copy) the specific product being submitted for approval. Failure to clearly identify the specific product being submitted will result in a rejection for the entire submittal. No substitutions of material or procedures shall be made without the written approval by the Owner's Representative.
 4. Equipment or materials installed or furnished without prior approval of the Owner's Representative, may be rejected by the Owner's Representative and the Contractor shall be required to remove such materials from the site at their own expense.
 5. Approval of substitution of material and/or products, other than those specified shall not relieve the Contractor from complying with the requirements of the contract documents

and specifications. The Contractor shall be responsible, at their own expense, for all changes that may result from the approved substitutions, which affect the installation or operations other items of their own work and/or the work of other Contractors.

- C. Samples: Samples of the equipment may be required at the request of the Owner's Representative if the equipment is other than that specified.
- D. Other Submittals: Submit for approval:
 - 1. Documentation of the installer's qualifications (prior to bid).
 - 2. Testing data from all required hydrostatic pressure testing.
 - 3. Backflow prevention device testing: as required by 17 CCR § 7605 (d), provide testing as required by the local authority immediately upon installation or relocation.
 - 4. Booster pump certification: Certification from the manufacturer's representative of correct installation per the manufacturer's requirements.
 - 5. Irrigation controller certification (if applicable): Certification from the manufacturer's representative of correct installation per the manufacturer's requirements.
 - 6. Turnover materials as listed within this specification section.

1.10 OBSERVATION OF THE WORK

- A. The Owner's Representative may observe the work at any time. They may remove samples of materials for verification or testing. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications, and re-testing of replacement materials, shall be paid by the Contractor
- B. The Owner's Representative shall be informed of the progress of the work so that the work may be observed at the following key times in the construction process. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification. The following observations are anticipated, with required advance notification times:
 - 1. Trenching, directional boring, and sleeving review: 7 days
 - 2. Hydrostatic pressure testing: 7 days
 - 3. Adjustment and coverage test: 7 days
 - 4. Pre-maintenance observation: 7 days
 - 5. Final acceptance / system malfunction corrections: 7 days

1.11 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

1.12 QUALITY ASSURANCE

- A. The contractor shall furnish and install a complete irrigation system, delivering sufficient water to maintain optimum plant health at all times and in an efficient manner. The irrigation system will provide water to all plants, even when not shown on the drawings.
- B. The Owner's Representative shall be the sole judge of the intent of the drawings and specifications and of the quality of all materials furnished in performance of the contract.
- C. The Contractor shall keep one copy of all drawings and specifications on the work site, in good order. The Contractor shall make these documents available to the Owner's Representative when requested.

- D. In the event of any discrepancies between the drawings and the specification, the more stringent shall apply, unless determined otherwise by the Owner's Representative.
- E. Installer Qualifications: The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the work.
 - a. Installer Field Supervision: The installer shall maintain on site an experienced full-time supervisor who can communicate in English with the Owner's Representative.
 - b. Submit the installer's qualifications for approval.

1.13 WARRANTY:

- A. The Contractor shall Warrantee all workmanship and materials for a period of 1 year (s), following final acceptance. This warranty shall run concurrently with plant warranty under Section 32 90 00 – Landscape Installation.
- B. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall include any plantings, soil, mulch or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.
- C. Neither the final acceptance nor any provision in the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects within a period of 7 days (s) from the date of notification.

1.14 SITE CONDITIONS

- A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the installation of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. All materials and equipment shall be stored properly and protected as required by the manufacturer. The Contractor shall be entirely responsible for damages or loss by weather or other cause to work under the contract. Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of the work.
- B. Deliver the products to the job site in their original unopened container with labels intact and legible at time of use.

1.16 PROTECTION

- A. The Contractor shall continuously maintain adequate protection of all their work from damage, destruction, or loss, and shall protect the owner's property from damage arising in connection with this contract. Contractor shall repair or make compensation for any such damage, destruction, loss or injury. Contractor shall adequately protect adjacent property as provided by law and the contract documents.
- B. The Contractor shall maintain sufficient safeguards, such as railings, temporary walks, lights, etc., against the occurrence of accidents, injuries or damage to any person or property resulting from their work, and shall alone be responsible for the same if such occurs.
- C. All existing paving, structures, equipment, work, and plant material shall be protected at all times from damage by workers and equipment. The Contractor shall follow all protection requirements including plant protection provisions. All damages shall be repaired or replaced at the Contractor's expense. Repairs and or replacement shall be to the satisfaction of the Owner's Representative, including the selection of a Contractor to undertake the repair or maintenance. Repairs shall be at no cost to the owner.

1. For trees damaged such that they are not expected to survive or which are severely disfigured, and that are too large to replace, the cost of damages shall be as determined by the Owner's arborist using accepted tree value evaluation methods.
 - D. Refrain from mechanical trenching within the drip line of any existing tree to remain. The Owner's Representative may require the Contractor to relocate proposed irrigation work, bore lines beneath roots, use hand tools, air spade, or similar technology to excavate trenches through and under the root system to avoid damage to existing tree root areas.
- 1.17 EXCAVATING AROUND UTILITIES
- A. Notification of Common Ground Alliance (C.G.A), 811, is required for all excavation.
 - B. Contractor shall carefully examine the civil, as-built, record, and survey drawings to become familiar with the existing underground conditions before digging. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by USA.
 - C. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain stakes and or markings set by others until parties concerned mutually agree to their removal.
 - D. Damage to existing work, including utilities, shall be repaired at the contractor's sole expense.
- 1.18 POINT OF CONNECTION
- A. The contractor shall coordinate water and power sources. All electrical connections shall be made by a licensed electrical Contractor per governing codes at the location(s) shown on the drawings.
- 1.19 TEMPORARY UTILITIES
- A. All temporary water, power, piping, wiring, meters, panels and other related appurtenances required between source of supply and point of use shall be provided by the Contractor and coordinated with the Owner's Representative. Existing utilities may be used with the written permission of the owner.
- 1.20 CUTTING, PATCHING, TRENCHING AND DIGGING
- A. The Contractor shall do all cutting, fitting, trenching or patching of their work that may be required to make its several parts come together as shown upon, or implied by, the drawings and specifications for the completed project.
- 1.21 USE OF PREMISES
- A. Contractor parking, and material and equipment storage shall be limited to areas approved by the Owner's Representative.
- 1.22 AS BUILT DRAWINGS
- A. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Owner's Representative.
 - B. Provide a completed as built set of drawings, in .pdf format, showing the irrigation system work as built to the Owner's Representative. The drawings shall include all information shown on the original contract documents and revised to reflect all changes in the work. The drawings shall include the following additional information:
 1. All valves shall be numbered by station and corresponding numbers shall be shown on the as built set of drawings.
 2. All main line pipe and irrigation equipment including sleeves, valves, controllers, irrigation wire runs which deviate from the locations on the contract documents.

3. Controllers, backflow preventers, remote control valves, grounding rods, shut-off valves, wire splice locations, sleeves, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed. Dimensions for lines shall be shown at no greater than a 50 ft. maximum interval.
4. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built set of drawings shall be labeled on each sheet "As Built Drawings", and include the company name, address, phone number and the name of the person who created the drawing and the contact name (if different).

1.23 CONTROLLER CHARTS:

- A. Provide one controller chart for each automatic controller installed.
 1. Inside each automatic controller, prepare and mount a color-coded chart showing the valves, main line, and systems of that controller. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that controller shall be shown. This chart shall be a plan, entire or partial, showing building, walks, roads and walls. The plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. The chart shall be approved by the Owner's Representative and shall be protected in laminated in a plastic cover and be secured to the inside back of the controller cabinet door.

1.24 TURNOVER MATERIALS

- A. Prepare and deliver to the Owner's Representative within ten calendar days prior to completion of construction, and in any case prior to final acceptance,
 1. Operations and Maintenance Binders: two 3-ring hard cover binders containing the following information:
 - a. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturers' representatives.
 - b. Catalog and parts sheets on all material and equipment.
 - c. Warranty statement on company letterhead. The start of the warranty shall be the date of final acceptance by the Owner.
 - d. Complete operating and maintenance instructions for all equipment.
 - e. Irrigation equipment manufacturers' warranties.
 - f. Controller Chart
 2. As-built drawings
 3. Backflow prevention device testing certification
 4. Pump and Controller certifications (if required)
 5. Equipment to be furnished under this section, including all parts, accessories, etc, and a minimum of (1) quick-coupler key, and an additional key for each (20) valves installed.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials shall be new when installed.
- B. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications based on the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the owner.

2.02 PIPING

A. Plastic pipe:

1. All pipe shall be free of blisters, internal striations, cracks, or any other defects or imperfections. The pipe shall be continuously and permanently marked with the following information: manufacturer's name or trade mark, size, class and type of pipe pressure rating, quality control identifications, date of extrusion, and National Sanitation Foundation (NSF) rating.
2. Pipe shall be rigid virgin polyvinyl chloride (PVC) 1220, Type 1, Grade 2 conforming to ASTM D 1785 and D2665 (scheduled pipe) or ASTM D1784 and D2241 (Standard diameter ratio (SDR)).
3. Gaskets shall conform to ASTM F477 and the assembled gasketed joints shall conform to ASTM D3139.
4. Mainlines (constant-pressure):
 - a. Pipe up to 2 inch diameter shall be Schedule 40 with solvent welded joints.
 - b. Pipes 2-1/2" to 3 inches in diameter shall be Class 315 (SDR 13.5) with solvent welded (SW) joints.
5. Laterals (non-constant pressure) shall be Schedule 40, 3/4" minimum size, with solvent welded joints.
6. Sleeves shall be schedule 40, minimum twice the diameter of the pipe, conduit, or other item to be sleeved.

B. Metal pipe:

1. Brass pipe shall be used only where specifically identified on the drawings, and shall be red brass, conforming to Federal Specification WW-P-351, with threaded fittings.
2. Galvanized pipe shall be used only where specifically identified on the drawings, and shall be hot dip galvanized continuous welded, seamless, Schedule 40, conforming to applicable current ASTM standards, with threaded fittings.

2.03 FITTINGS AND CONNECTIONS:

- A. Polyvinyl chloride pipe fittings and connections: Type II, Grade 1, Schedule 40 or 80 conforming to ASTM D2466 and D2467, as indicated, high impact molded fittings, manufactured from virgin compounds as specified for piping tapered socket or molded thread type, suitable for either solvent weld or threaded connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable unless specifically noted. Furnish fittings permanently marked with following information: nominal pipe size, type and schedule of material, and National Sanitation Foundation (NSF) seal of approval.
 - a. All fittings at valve assemblies shall be schedule 80,
 - b. Unless otherwise specified, all other fittings shall be schedule 40
- B. Brass pipe fittings, unions and connections: standard 125 pound class 85% red brass fittings and connections, IPS threaded.
- C. PVC Schedule 80 threaded risers and nipples: Type I, grade 1, Schedule 80, high impact molded, manufactured from virgin compounds as specified for piping and conforming to ASTM D2464. Threaded ends shall be molded threads only. Machined threads are not acceptable.
- D. Galvanized pipe fittings shall be galvanized malleable iron ground joint Schedule 40 conforming to applicable current ASTM standards.

2.04 SOLVENT CEMENTS, PRIMERS, AND THREAD LUBRICANT

- A. Solvent cements shall be Low-VOC and comply with ASTM D2564. Primers shall be Low-VOC, any comply with ASTM F656. Socketed solvent welded joints shall be made per

recommended procedures for joining PVC plastic pipe and fittings with PVC solvent cement and primer by the pipe and fitting manufacturer and procedures outlined in the appendix of ASTM D2564.

- B. Thread lubricant shall be Teflon tape, "extra-heavy," or "full density", color: pink.
- C. Pipe Joint Compound (Pipe dope) shall be used on metal threaded connections only, contain PTFE (Polytetrafluoroethylene), and shall be suitable for use with plastic materials. Ensure no compound enters the lines.

2.05 BACKFLOW PREVENTION DEVICES

- A. Backflow prevention devices shall be certified to NSF/ANSI 372 shall be ASSE Listed 1013, rated to 180 degree F, on "List of Approved Backflow Prevention Assemblies maintained by the USC Foundation and available at <http://fccchr.usc.edu/list.html>, and supplied with full port ball valves at each side for testing.
- B. Backflow preventers shall be as indicated on the drawings.
- C. Provide freeze protection as indicated on the drawings. If not indicated, minimum accepted shall be a green lockable blanket, consisting of minimum R-13 fiberglass matte core and UV-resistant exterior polyvinyl shell, color: green, as manufactured by Bestchoice, Vallejo CA, or equal.

2.06 PRESSURE REGULATOR

- A. Pressure regulator shall be NSF/ANSI 372 certified, consisting of low lead cast bronze body (ASTM B 584), with a separate bronze (ASTM B 584) or brass (ASTM B 16) access cap threaded to the body.
- B. Pressure regulator shall be as indicated on the drawings.

2.7. Wye Strainer

- C. Wye strainer shall be as indicated on the drawings.

2.07 BACKFLOW PREVENTER ENCLOSURE

- A. A heavy-duty steel mesh enclosure with rust proof finish. The cage shall be sized to allow space for all piping and equipment associated with the Backflow Preventer. The enclosure shall include a tamper-resistant locking mechanism. Lock(s) shall be provided by the Owner. Enclosure shall be installed on a concrete pad, minimum 4" thick.
- B. Backflow Preventer enclosure shall be as indicated on the drawings.

2.08 BOOSTER PUMP

- A. Booster pump shall be housed in a sturdy, locking, weather-resistant enclosure, furnished for exterior protection, and installed on a concrete pad, minimum 4" thick.
- B. Booster pump shall be as indicated on the drawings.

2.09 SHUT OFF VALVES

- A. For constant pressure applications, shut-off valves shall be gate-type.
 - 1. For mainlines 3 inches in diameter or less, valves shall be rated for 200 PSI, cast bronze with threaded ends, Nibco T-113 or equal.
 - 2. For mainlines 4 inches in diameter or greater, valves shall be rated for 250 PSI, epoxy coated cast iron body with push-on ends, Leemco LMV series, American Series 2500, Nibco P-619 series, or equal.
- B. For Remote Control Valve (RCV) assemblies, shut-off valves shall be ball-type.
 - 1. For assemblies up to 2-1/2 inches in diameter, PVC schedule 80 rated for 235 psi or greater with integral unions and EDPM O-rings, Spears True Union, Cepex True Union,

- or equal.
 - 2. For assemblies 3 inches in diameter or greater, brass or bronze body with a continuous working pressure of at least 300 psi.
 - C. All ball valves located at a valve manifold shall be the same size as the sub-main line (1 inch minimum). Provide pipe-reducing adapters, as required. All ball valves in line shall be the same size as the pipe.
- 2.10 CHECK VALVES
- A. Point-of-Connection Swing or spring check valves 2 inch and smaller shall be 200 lbs., W.O.G., bronze construction with replaceable composition, neoprene or rubber disc and shall meet or exceed federal specification WW-V- 5ld, class a, type iv.
 - B. Anti-drain valves shall be of heavy-duty virgin PVC construction with female pipe thread inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-drain valves shall be field adjustable against draw out from 5 to 40 feet of head.
 - C. Inline Check Valves, as required to prevent low head drainage, where head exceeds available manufacturer's options for check valve(s) at emitter(s):
 - 1. Where emitters are higher in elevation relative to RCV's, install spring-assisted swing check valves (only install swing check valves if available pressure is insufficient)
 - 2. Where emitters are lower in elevation relative to RCV's install adjustable spring check valves to allow flow during normal operation, but restrict flow after control valve operation.
 - 3. Acceptable manufacturers include Spears, Dultimeter, or equal.
 - D. Other valves as indicated on the plans.
- 2.11 MAINLINE AIR RELIEF VALVES
- A. Valve shall be manufactured per AWWA C512, with cast iron body and stainless steel float, with a minimum working pressure of 150psi.
- 2.12 REMOTE CONTROL VALVES (RCV)
- A. Remote control valves shall be electrically operated, single seat, normally closed configuration, equipped with flow control adjustment and capability for manual operation.
 - B. Valves shall be actuated by a normally closed low wattage solenoid using 24 volts, 50/60 cycle solenoid power requirement. Solenoid shall be epoxy encased.
- 2.13 MASTER CONTROL VALVES
- A. Master Control Valve shall be compatible with the irrigation controller and shall be as indicated on the drawings.
- 2.14 FLOW SENSOR
- A. Flow sensor shall be compatible with the irrigation controller and shall be as indicated on the drawings.
- 2.15 QUICK COUPLER VALVES
- A. Quick coupler valves shall be a one or two-piece, heavy-duty brass construction with a working pressure of 150 PSI with a built in flow control and a self-closing valve.
 - B. Quick coupler shall be equipped with red brass cap covered with durable yellow thermo-plastic rubber cover. Key size shall be compatible with quick coupler and of same manufacturer.
 - C. Quick couplers shall be installed with anti-rotation wing stabilizers, either solid red brass or epoxy-coated ductile iron

2.16 HEADS, BODIES, EMITTERS, AND NOZZLES

- A. All equipment shall conform to ASABE ICC 802 and shall be as indicated on the drawings.
- B. All sprinkler bodies shall have check valves installed where required to prevent low head drainage. Swing joints, risers, and nipples for all heads shall be the same size as the riser opening in the sprinkler body and fabricated as shown on the drawings.
- C. All drip emitters shall be pressure compensating (PC).

2.17 AUTOMATIC CONTROLLER

- A. Controller shall be housed in a sturdy, locking, weather-resistant case, furnished for maximum exterior protection.
- B. Controller shall be equipped with evapo-transpiration (ET) sensor, which adjusts the controller programming based on local climatic conditions. The sensor shall also have a rain sensing shut-off switch, wind sensing shut off switch, and freeze sensing shut-off of switch.
 - 1. If a moisture sensor is used in lieu of an evapo-transpiration sensor an additional sensor, which has a rain-sensing shut-off switch, wind sensing shut-off switch, and freeze sensing shut-off switch shall be provided.
- C. Automatic controller shall be as indicated on the drawings.

2.18 CONTROLLER DECODERS

- A. All decoders shall be per the controller manufacturer's specifications.
- B. Decoder model number shall be as shown on the drawings.

2.19 ELECTRICAL CONTROL WIRING

A. LOW VOLTAGE, TWO-WIRE SYSTEMS

- 1. All wiring shall be per the controller manufacturer's specifications and recommendations, including sizing based on the longest leg or loop, and ASIC guidelines for grounding.
 - a. For Hunter ACC2 two-wire systems:
 - 1.) Two-wire cable shall be Hunter IDWIRE, Paige P7354D, or other approved two-conductor, minimum 14-gauge, solid-core copper wire, twisted with a minimum lay of 4", and PE insulation with a minimum wall thickness of .045". A protective overall jacket must be manufactured of HDPE, with a minimum wall thickness of .035", and approved for direct burial installation.
 - 2.) Wire splices and ends shall be made with Hunter DBRY-6, 3M-DBY/R-6, or equal wire nut and gel-filled encapsulating connectors.

B. HIGH VOLTAGE

- 1. Shall be of type as required by local codes and ordinances.
- 2. Shall be of proper size to accommodate needs of equipment served.

2.20 VALVE BOXES AND MATERIALS

- A. Valve boxes: valve boxes shall be constructed of ABS (acrylonitrile butadiene styrene) plastic, green for turf areas, brown for planting areas, with rigid base and sides and shall be supplied with bolted cover secured with stainless steel penta bolts (anit-tamper). Provide box extensions as required.
 - 1. Master valves, flow sensors, check valves, and remote-control irrigation valves shall use a 14 inch x 19 inch x 12 inch rectangular box (minimum size).
 - 2. Quick coupler valves, shut-off valves, wire d grounding rods shall use a 10 inch circular box.

2.21 CONCRETE THRUST BLOCKS

- A. Concrete thrust blocks shall be constructed for all lines 2-1/2" or greater without restrained joints, and sized per the pipe manufacturers' requirements, as indicated on the drawings, or per local requirements, whichever is most stringent.

2.22 VALVE IDENTIFICATION TAGS

- A. Valve Identification Tags shall be 2.25 inch x 2.65 inch polyurethane. Color: yellow for non-potable water; purple for recycled water. Tags shall be permanently attached to each RCV with tamper-resistant seals as indicated on the drawings. Tags shall be consistently labeled X-ZZ or XZZ (where X is the controller letter and ZZ is the valve number).

2.23 EQUIPMENT TO BE FURNISHED TO OWNER

- A. Two (2) sets of keys for each automatic controller.
- B. Two (2) 48 inch tee wrenches for operating gate valves 3" or larger.
- C. Three (3) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
- D. Five (5) sprinkler heads, nozzles, shrub adapters, nozzle filter screens, for each type used on the project.
- E. Two (2) quick coupler keys to match manufacturer type of quick coupler.

2.24 INCIDENTAL MATERIALS AND EQUIPMENT

- A. Furnish all materials and equipment not specified above, but which are necessary for completion of the work as intended.

2.25 MAINLINE LOCATOR TAPE

- A. 3 inch wide plastic detectable locator tape.

2.26 BEDDING SAND

- A. Sand shall consist of natural or manufactured granular material, free of organic material, mica, loam, clay or other substances not suitable for the intended purpose.
- B. Sand shall be masonry sand ASTM C 144 or coarse concrete sand, ASTM C 33.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Code requirements shall be those of state and municipal codes and regulations locally governing this work, providing that any requirements of the drawings and specifications, not conflicting therewith, but exceeding the code requirements, shall govern unless written permission to the contrary is granted by the Owner's Representative.
- B. Exercise extreme care in excavating and working in the project area due to existing utilities and irrigation systems to remain (if any). Contractor shall be fully responsible for expenses incurred in the repair of damages caused by their operation.
 - 1. The Contractor is responsible for identifying and maintaining existing irrigation main lines that supply water to areas on the site as noted on the drawings and outside of the proposed limit of work. The Contractor shall relocate or replace existing irrigation main line piping as required to provide uninterrupted sufficient water to maintain plant health to all irrigated areas on site. Providing water includes hand watering and/or watering trucks.
- C. Plan locations of backflow preventers, valves, controllers, irrigation lines, sleeves, and other equipment are diagrammatic and indicate the spacing and relative locations. Final locations shall be determined on-site and adjusted as necessary and as directed to meet existing and proposed conditions and obtain complete water coverage. Changes from locations shown

shall be made if necessary to avoid existing and proposed plants, piping, utilities, structures, etc. or when directed by the Owner's Representative and at the Contractor's expense.

- D. Prior to any work the Contractor shall stake out locations of all mainlines, valves, pumps, controllers, and backflow devices using an approved staking method and maintain the staking of the approved layout in accordance with the drawings and any required modifications. Flag or mark all overhead emitter locations. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area.
- E. Stub out main line at all end runs and as shown on drawings. Stub out wires for future connection where indicated on plan and as directed.
- F. Permission to shut off any existing in-use irrigation or water line must be obtained 48 hours in advance, in writing from the Owner. The Contractor shall receive instructions from the Owner's Representative as to the exact length of time of each shut-off.
- G. No fittings shall be installed on pipe underneath pavement or walls.
- H. Prior to starting any work, Contractor shall measure the existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of recording to Owner's Representative.

3.02 TRENCHING, DIRECTIONAL BORING AND SLEEVING

- A. Perform all trenching, directional boring, sleeving and excavations as required for the installation of the work included under this section, including shoring.
- B. The Contractor may directional bore lines where it is practicable or where required on the plans.
 - 1. Extend the bore 1' past the edge of pavement unless noted differently on the plans.
 - 2. Cap ends of each bore and locate ends at finished grade using 4 x 4 posts.
- C. Make trenches for mains, laterals and control wiring straight and true to grade and free of protruding stones, roots or other material that would prevent proper bedding of pipe or wire.
- D. Excavate trenches wide enough to allow a minimum of 3 inches between parallel lines and 8 inches from lines of other trades. All lines shall be able to be serviced or replaced without disturbing the other lines.
- E. Trenches for pipelines shall be made of sufficient depth to provide the minimum cover from finished grade as follows:
 - 1. Pressure mainline: 18 inches below finish grade in planted areas and 24 inches below paved areas in Schedule 40 PVC sleeves.
 - 2. Lateral lines: 12 inches below finish grade and 24 inches below paved areas in Schedule 40 PVC sleeves.
 - 3. Polyethylene drip distribution tubing: 4 to 6 inches below grade.
 - 4. Sub-surface inline drip tubing: 4 to 6 inches below grade.
 - 5. Control wiring: to the side of pressure main line and 24 inches below paved areas in Schedule 40 PVC sleeves.
- F. Backfill the trench per the requirements in paragraphs "Backfilling and Compacting" below.

3.03 PIPE INSTALLATION

- A. General Pipe Installation
 - 1. Exercise caution in handling, loading, and storing, of plastic pipe and fittings to avoid damage.
 - a. The pipe and fittings shall be stored under cover until using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load at any point.
 - b. All pipe that has been dented or damaged shall be discarded.

2. Trench depth shall be as specified above from the finish grade to the top of the pipe.
 3. Installation of all pipe and fittings shall be in strict accordance with manufacturer's specifications.
- B. Polyvinyl Chloride Pipe (PVC) Installation
1. Under no circumstance is pipe to rest on concrete, rock, wood blocks, construction debris or similar items.
 2. No water shall be permitted in the pipe until a period of at least 24 hours has elapsed for solvent weld setting and curing.
 3. Install assemblies and pipe to conform to drawings and where shown diagrammatically on drawings. All fittings that are necessary for proper connections such as swing joints, offsets, and reducing bushings that are not shown on details shall be installed as part of the work.
 4. Solvent weld or threaded plastic pipe:
 - a. Pipe shall be cut using approved PVC pipe cutters where practicable. Sawed cuts 1" or smaller lines are disallowed. All field cuts shall be beveled to remove burrs and excess before gluing.
 - b. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.
 - c. Plastic to metal connections shall be made with schedule 80 nipples. No male metal threads shall be connected to plastic materials. Connection shall be made with two (2) wraps of Teflon tape and hand tightened plus one turn with a strap wrench.
 - d. Snake pipe in trench to allow one (1) foot of expansion and contraction per 100 feet of straight run.
 - e. Threaded pipe joints shall be made using Teflon tape. Solvent or Pipe-dope shall not be used with threaded joints. Pipe shall be protected from tool damage during assembly. All damaged pipe shall be removed and replaced. Take up threaded joints with light wrench pressure.
 - f. Load pipe at 10 foot intervals with backfill to prevent arching and slipping under pressure. Other than this preliminary backfill, all pipe joints, fittings and connections are to remain uncovered until successful completion of hydrostatic testing and written approval of the testing report.
 - g. Concrete thrust blocks shall be constructed behind all non-restrained pipe fittings 2-1/2" inches in diameter or larger at all changes of direction of 45 degrees or more.
- C. Metal Pipe Installation
1. All joints shall be threaded with Teflon tape or pipe joint compound used on all threads.
 2. Dielectric bushings shall be used in any connections of dissimilar metals.
- 3.04 TRENCHING, DIRECTIONAL BORING, AND SLEEVING REVIEW:
- A. Upon completion and installation of all trenching, directional boring, and sleeving, the Owner's Representative shall visually observe all installed irrigation control wiring, lines, and fittings. Do not cover any wires, lines or fittings until they have been tested and observed by the Owner's Representative unless authorized in writing.
- 3.05 FLUSHING
- A. Openings in piping system during installation are to be capped or plugged to prevent dirt and debris from entering pipe and equipment. Remove plugs when necessary to flush or complete system.
 - B. After completion and prior to the installation of any terminal fittings, the entire irrigation system shall be flushed to remove dirt, debris and other material.
- 3.06 HYDROSTATIC PRESSURE TESTING

- A. After flushing, and the installation of valves the following tests shall be conducted in the sequence listed below. The Contractor shall furnish all equipment; materials and labor necessary to perform the tests and all tests shall be conducted in the presence of the Owner's Representative.
- B. Water pressure tests shall be performed on all pressure main lines before any couplings, fittings, valves and the like are concealed.
- C. Immediately prior to testing, all irrigation lines shall be purged of all entrapped air or debris by adjusting control valves and installing temporary caps forcing water and debris to be discharged from a single outlet.
- D. Test all pressure main line at 150 PSI. For a minimum of four (4) hours with an allowable loss of 5 PSI. Pressure and gauges shall be read in PSI, and calibrated such that accurate determination of potential pressure loss can be ascertained.
- E. Re-test as required until the system meets the requirements. Any leaks, which occur during test period, will be repaired immediately following the test. All pipe shall be re-tested until final written acceptance.
- F. Submit a written, signed report to the Owner's Representative including the date, the start time and initial water pressure readings, the finish time and final water pressure readings, and the type of equipment used to perform the test.

3.07 BACKFLOW PREVENTER TESTING

- A. Test all installed backflow prevention devices as required by Title 17 of the California Code of Regulations Section 1706. Testing shall be performed by a Backflow Prevention Assembly Tester with a current certification from the American Water Works Association, and all local requirements.

3.08 CONTROLLER AND BOOSTER PUMP TESTING AND CERTIFICATION

- A. Booster Pump shall be certified by ATV-Power. Contact Chris Murray at 916-429-9724.
- B. Controller installation review to be conducted by Hunter representative.

3.09 BACKFILLING AND COMPACTING

- A. Irrigation trenches shall be backfilled with material free of rocks, clumps, or debris 1 inch in diameter or larger.
- B. Place backfill in lifts not exceeding 8" deep and compact as follows:
 - 1. Under pavement and within 1 foot of the edge of pavement: 95% or greater relative density.
 - 2. Backfill of subsoil in planting areas: Between 85 and 90% relative density.
- C. Finish grade of all trenches shall conform to adjacent grades without dips or other irregularities. Spread excess soil on site and dispose of debris off site at no additional cost to the Owner.
- D. Any settling of backfill material during the Establishment or Warranty period shall be repaired at the Contractor's expense, including any replacement or repair of soil, lawn, and plant material or paving surface.

3.10 RESURFACING PAVING OVER TRENCHES

- A. Restore all surfaces and repair existing underground installations damaged or cut as a result of the excavation to their original condition, satisfactory to the Owner's Representative.
- B. Trenches through paved areas shall be resurfaced with same materials quality and thickness as existing material. Paving restoration shall be performed by the project paving Sub-contractor or an approved Contractor skilled in paving work.

- C. The cost of all paving restoration work shall be the responsibility of the irrigation Contractor unless the trenching through the paving was, by previous agreement, part of the general project related construction.

3.11 EQUIPMENT INSTALLATION

A. General:

1. All equipment and accessories shall be installed per all installation requirements and recommendations of the product manufacturer.
2. Install all equipment at the approximately at the location(s) and as designated and detailed on the drawings. Verify all locations with the Owner's Representative.
3. Install all valves within a valve box of sufficient size to accommodate the installation and servicing of the equipment. Group valves together and locate in planted areas.
4. All irrigation systems that are using water from potable water systems shall require backflow prevention. All backflow prevention devices shall meet and be installed in accordance with requirements set forth by local codes and the health department.

B. Pressure Regulators:

1. Set adjustable regulators for required PSI per manufacturer's specifications.

C. Check Valve:

1. Install check valves at locations necessary to prevent low head run off, where elevation differences exceed manufacturer's option for in-head check valves.

D. Remote Control Valves (RCV):

1. Install one RCV per valve box.
2. Install boxes no closer than 8 inches from edge of paving and perpendicular to edge of paving and parallel to each other. Allow 12 inches clearance between adjacent valve boxes.

E. Quick coupler valve:

1. Install each quick coupler valve in its own valve box, aligned as indicated in the drawings.
2. Install one stabilizer/anchor per manufacturer's instructions. Anchor shall be ductile iron, epoxy coated, with stainless steel fastening bolt, as manufactured by Harco, Leemco, or equal.

F. Mainline Air Relief Valves

1. For mainlines longer than 2,000 l.f. or where booster pumps are used, install minimum of (1) continuous-operation air relief valve at the mainline high point to evacuate air and prevent water hammer. Install within round valve box.

G. Sprinkler Assemblies:

1. All main lines and lateral lines, including risers, shall be flushed and pressure tested before installing sprinkler heads.
2. Install specified sprinkler heads as shown on the drawings. Adjust layout for full head-to-head coverage. Spacing of heads shall not exceed the maximum spacing recommended by the manufacturer.
3. All sprinkler heads shall be offset from adjacent edges and set perpendicular to finish grade unless in sloped conditions as shown on the drawings.
4. Risers and Swing Joints: shall be sized equal to the inlet of the head.
 - a. For pop-up ABS bodies with spray, bubbler, or and rotary nozzles: pre-manufactured with marlex or polyethylene street ells and polyethylene tubing, minimum 0.49 inch outside diameter, rated to 150 psi; Hunter SJ-series or equal.
 - b. For pop-up ABS rotors: shall be pre-manufactured PVC with O-Ring seals and three axis movement, Hunter HSJ-series, Lasco G-series, or equal.

- c. For individual bubblers or drip emitters not on pop-up bodies: shall be premanufactured flexible risers, polyethylene or PVC, with male pipe thread ends, Hunter IH-series or equal, to include screen with integral check valve.

H. Irrigation Controllers:

1. Connect control wiring in the numerical sequence as shown on the drawings.
2. Controller shall be tested with completed electrical connections.
3. Ground controller per manufacturer's requirements. At minimum, grounding shall include:
 - a. one 5/8-inch x 8-foot copper rod installed per irrigation controller (and where multiple controllers are not connected to the same ground rod), at the first decoder along the two-wire path, and at decoders with intervals of every 300' (or the nearest decoder to the 300' interval) along the two wire path thereafter.
 - b. The top of each rod shall be installed inside a 10-inch round valve box, with the rod installed as close as practical to the controller. If a pedestal enclosure is used, the ground rod may be installed through the pedestal base. Under no circumstances shall the rods be shortened.
 - c. At controllers, a #6 AWG solid copper wire shall be used to connect from the ground lug of the transient protection board to the copper rod. Brass clamps specifically designed to secure the copper wire to the grounding rod shall be used. There shall be no kinks or sharp bends in the wire
 - d. Each wire may be wrapped around the rod and brazed in place as an alternative to clamping. Braze the wire to the rod for at least one circumference of the rod.

I. Wiring:

1. General:
 - a. All wire ends, including all wires from all decoders, valves, and other equipment, whether used or not, shall be encapsulated in waterproof connectors.
 - b. All wire insulation shall be intact and free of nicks and cuts. Wire shall not be bent.
 - c. Install lightning protection per the manufacturer's requirements and recommendations.
2. Two-Wire Low Voltage Control Wiring:
 - a. Per manufacturer's requirements and recommendations.
3. High Voltage
 - a. All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.
 - b. The Contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on drawings.

J. Valve boxes:

1. Install one valve box for each type of valve, installed as shown on the drawings.
2. Gravel shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after valve is backfilled and compacted.
3. Permanently label valve type on valve box lid by either: pre-lettered tags affixed with stainless steel rivets, or heat-branding using typeset tools, or other method approved by the Owner's Representative. Valves labeled as follows: check valve – CV; shut-off valve - SO; remote control valve – RCV; quick coupler – QC; master valve – MV; and flow sensor - FS.

K. Tracer wire:

1. Tracer wire shall be installed with non-metallic plastic irrigation main lines where controller wires are not buried in the same trench as the main line.
2. The tracer wire shall be placed on the bottom of the trench under the vertical projection of the pipe with spliced joints soldered and covered with insulation type tape.

3. Tracer wire shall be of a color not used for valve wiring. Terminate wire in a valve box. Provide enough length of wire to make a loop and attach wire marker with the designation "tracer wire".

L. Drip Installation:

1. Install pressure reducers when operating pressure exceeds specific drip tubing fitting recommendation or requirement.
2. Cap or plug all openings as soon as lines have been installed to prevent the intrusion of materials that would obstruct the pipe. Leave in place until removal is necessary for flushing or completion of installation.
3. Thoroughly flush all water lines before installing emitters.

3.12 ADJUSTMENT AND COVERAGE TEST

- A. Adjustment: The Contractor shall flush and adjust all sprinkler heads, valves and all other equipment to ensure function according to the manufacturer's data. Adjust all sprinkler heads not to overspray or runoff onto walks, roadways and buildings when under normal operating pressure and during times of normal prevailing winds.
- B. Coverage test:
 1. The Contractor shall perform a coverage test in the presence of the Owner's Representative after all sprinkler heads have been installed, flushed and adjusted. Test each valve or zone to demonstrate uniform and adequate coverage.
 2. Any adjustments shall be done by the Contractor prior to substantial completion at the direction of the Owner's Representative at no additional cost. Adjustments may include realignment of lines, addition or removal of heads, and changes in nozzle type or size.
 3. The entire irrigation system shall be operating properly prior to beginning any planting operations, unless approved otherwise by the Owner's Representative.

3.13 CLEAN-UP

- A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
 1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- B. Once installation is complete, wash all soil from pavements and other structures.
- C. Make all repairs to grades ruts, and damage to the work or other work at the site.
- D. Remove and dispose of all excess soil, packaging, and other material brought to the site by the Contractor.

3.14 PROTECTION & MAINTENANCE

- A. The Contractor shall protect the work from damage due to operations during Landscape Installation, other Contractors, trespassers, and all other forces except natural disasters.
- B. Maintain the irrigation system through the Establishment Period, according to Section 32 98 00 – Landscape Maintenance, until final project acceptance.

END OF SECTION 32 84 00

SECTION 32 90 00

LANDSCAPE PLANTING

PART 1 – GENERAL

1.01 SUMMARY

- A. The scope of work includes all labor, materials, and any other items, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and complete installation of planting (also known as "landscaping"), as shown on the drawings and as specified herein.
- B. The scope of work in this section includes, but is not limited to, the following:
 - 1. Locate, purchase, deliver and install all specified plants.
 - 2. Care of installed plant material and related work, including watering, mulching, fertilizing, staking, and pruning.
 - 3. Finish grading of all planting areas
 - 4. Maintenance of work until the beginning of the warranty period.
 - 5. Clean up and disposal of all excess and surplus material.
 - 6. Maintenance of all specified plants during the Establishment Period.
 - 7. Warranty.

1.02 CONTRACT DOCUMENTS

- A. Construction drawings and these specifications are a part of the contract documents. Refer to contract for a complete list of all contract documents. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.03 REFERENCES

- A. The following specifications and standards of the organizations and documents listed form a part of the specification to the extent required by the references thereto. If the requirements of any referenced specifications and standards conflict with each other, the more stringent requirement shall apply unless determined otherwise by the Owner's Representative.
 - 1. State of California, Department of Food and Agriculture, Regulations for Nursery Inspections, Rules and Grading.
 - 2. ANSI Z60.1 American Standard for Nursery Stock, most current edition.
 - 1. ASTM D5268 - Topsoil used for Landscaping Purposes.
 - 3. ANSI A 300 – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current edition.
 - 4. Interpretation of plant names and descriptions shall reference the following documents. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
 - a. The New Sunset Western Garden Book, Oxmoor House, latest edition.
 - b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; latest edition.
 - c. Glossary of Arboricultural Terms, International Society of Arboriculture (ISA), latest edition.

1.04 VERIFICATION

- A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall check and verify all dimensions and quantities and shall immediately inform the Owner's Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Owner's Representative.

- B. In the case of a discrepancy in the plant quantities between the plan drawings and the plant call outs, list or plant legend, the number of plants or square footage of the planting area on the drawings shall be deemed correct and prevail.

1.05 PERMITS AND REGULATIONS

- A. The Contractor shall obtain and pay for all permits related to this section of the work unless otherwise noted. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner's Representative in writing, including a description of any necessary changes to the work and resulting changes to the contract price.
- B. Wherever references are made to standards or codes in accordance with which the work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.
- C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply unless determined otherwise by the Owner's Representative.

1.06 PROTECTION OF WORK, PROPERTY, AND PERSONS

- A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to his/her actions.

1.07 CORRECTION OF WORK

- A. The Contractor, at their own cost, shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work and seasonal weather demands.

1.08 DEFINITIONS

All terms in this specification shall be as defined in the "Glossary of Arboricultural Terms" or as modified below.

- A. Boxed plants: A container root ball package made of wood in the shape of a four-sided box.
- B. Container plant: Plants that are grown in and/or are currently in a container including boxed trees.
- C. Defective plant: Any plant that fails to meet the plant quality requirement of this specification.
- D. Final Acceptance: The date after completion of the establishment period when the Owner's Representative accepts the project. This period may extend past the time listed in this specification if maintenance during the establishment period is not performed satisfactorily, or if the project is not ready for acceptance at the end of the Establishment period.
- E. Field grown trees: Trees growing in field soil for at least 12 months prior to harvest.
- F. Healthy: Plants that are growing in a condition that expresses leaf size, crown density, color; and with annual growth rates typical of the species and cultivar's horticultural description, adjusted for the planting site soil, drainage and weather conditions.
- G. Establishment period: The time period, as defined in this specification, during which the Contractor provides maintenance until project acceptance.
- H. Planting Soil: native or imported topsoil in planting areas, amended as required by this section.
- I. Root ball: The mass of roots including any soil or substrate that is shipped with the tree within the root ball package.

- J. Root collar (root crown, root flare, trunk flare, flare): The region at the base of the trunk where the majority of the structural roots join the plant stem, usually at or near ground level.
- K. Shrub: Woody plants with mature height approximately less than 15 feet.
- L. Substantial Completion: The date when the work in this section is substantially complete and the Owner's Representative authorizes the establishment period to begin. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.
- M. Stem girdling root: Any root more than 1/4 inch in diameter currently touching the trunk, or with the potential to touch the trunk, above the root collar approximately tangent to the trunk circumference or circling the trunk. Roots shall be considered as Stem Girdling that have, or are likely to have in the future, root to trunk bark contact.
- N. Structural root: One of the larger roots emerging from the root collar.
- O. Tree: Single and multi-stemmed plants with mature height approximately greater than 15 feet.

1.09 SUBMITTALS

- A. Comply with general conditions, special conditions, Division 1 sections and other contract documents. All submittals shall be made at least 4 weeks prior to delivery of materials.
 - 2. Product data: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval.
 - 3. Samples: Submit samples of each product and material noted in the contract documents to the Owner's Representative for approval. Label samples to indicate product, characteristics, and locations in the work.
 - 4. Plant sources: within 30 days of award of contractor, and at least 30 days prior to delivery, submit sources of all plants and substitution requests, if any, to the Owner's Representative for approval.
 - 5. Soils Fertility Test Results: obtain soil samples, quantity as indicated on the drawings, from representative planting areas, and at anticipated plant rooting depths. Mix multiple samples together. Submit for agronomic testing to a certified laboratory.
- B. Materials Test Reports: Submit topsoil test reports to Landscape architect minimum 6 weeks prior to placement of topsoil.
 - 1. Provide location of topsoil borrow area if topsoil is to be imported.
 - 2. Provide name of independent soil testing laboratory.
 - 3. Provide date of sampling and testing.
- C. Submittals shall be available at all times to the Wal-Mart Construction Manager
- B. Close out submittals: Submit to the Owner's Representative for approval:
 - 1. Plant maintenance data and requirements.
 - 2. Warranty on company letterhead

1.10 QUALIFICATIONS

- A. Installer Qualifications: The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the work, including the handling and planting of large specimen trees in urban areas. The same firm shall install or amend planting soil, establish final grades in planting areas, and install and plant material.
 - 1. Installer Field Supervision: When any planting work is in progress, installer shall maintain, on site, a full-time supervisor with a minimum of five years' experience with the work, and who can communicate in English.
 - 2. The installer's crew shall have a minimum of 2 years experienced in the installation of

Planting Soil, Plantings, and Irrigation (where applicable) and interpretation of plans and specifications.

3. Prior to bidding the work, submit references of past projects, employee training, and certifications that support that the Contractor(s) meet all the above installer qualifications and applicable licensures.

1.11 PRE-CONSTRUCTION CONFERENCE

- A. Convene a pre-work meeting minimum 30 days prior to commencing work on this Section. Review conditions of operations, procedures, and coordination with related work. The pre-work teleconference shall be set up as a conference call with the Landscape Architect and Irrigation Designer and will be combined with a discussion on irrigation.
 1. Review photographs provided by Contractor's tree grower nursery of trees to be approved by Landscape Architect.
 2. Review planting schedule and maintenance.
 3. Review required inspections, schedule of topsoil testing, and environmental procedures.

1.12 OBSERVATIONS

- A. The Owner's Representative may observe the work at any time. They may remove samples of materials for verification or testing. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications, and re-testing of replacement materials, shall be paid by the Contractor.
- B. The Owner's Representative shall be informed of the progress of the work so that the work may be observed at the following key times in the construction process. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification. The following observations are anticipated, with required advance notification times:
 1. SITE CONDITIONS PRIOR TO THE START OF PLANTING: review the soil and drainage conditions: 7 days.
 2. PLANT LAYOUT REVIEWS(S): Review of the plant layout: 7 days.
 3. PLANT QUALITY: Review at the time of delivery and prior to installation: 7 days
 4. COMPLETION OF THE PLANTING: Review the completed planting: 10 days

1.13 WARRANTY

- A. Warranty shall begin on the date of Final Acceptance and continue for 1 year. If When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
- B. Plants determined to be defective by the Owner's Representative shall be removed by the contractor immediately upon notification by the Owner's Representative and replaced by the contractor without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
- C. The Contractor is exempt from replacing plants, during the warranty period, that are removed by others, lost, or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.
- D. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
- E. The warranty of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. If a replacement plant is not acceptable during or at the end of the extended warranty period, the Owner's Representative may elect alternate replacement items or credit. Alternate replacement items are not protected under a warranty

period.

1.14 SELECTION AND OBSERVATION OF PLANTS

- A. Submit to the Owner's Representative, for approval, plant sources including the names and locations of nurseries, and a list of the plants they will provide. The plant list shall include the botanical and common name and the size.
- B. For all trees greater than 24: box, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the Owner's Representative via photograph does not preclude the Owner's Representative's right to reject material while on site.
- C. The Owner's Representative may review all plants, prior to delivery, during delivery, or after delivery. Unacceptable material shall be rejected, or if substandard elements can be corrected, corrective action may be taken by the contractor at his/her sole expense. Review or approval of any plant shall not prevent that plant from later rejection if the plant quality changes or previously existing defects become apparent that were not observed.
- D. All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

1.15 PLANT SUBSTITUTIONS

- A. Submit all requests for substitutions of plant species, or size to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of nurseries contacted in the search for the required plant. Requests shall include proposed substitutions with similar characteristics to the specified material.

1.16 SITE CONDITIONS

- A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.
 - 1. Should subsurface drainage or soil conditions be encountered which would be detrimental to the plant material, the Contractor shall notify the Owner's Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner's Representative of such conditions, he/she shall remain responsible for plant material under the warranty.
- B. This specification requires that all Landscape Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.
 - 1. Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been observed and approved by the Owner's Representative.
- C. Planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.
 - 1. Do not install plants into saturated or frozen soils. Do not install plants during inclement weather, such as rain, snow, or during extremely hot, cold or windy conditions.

1.17 UTILITIES

- A. Notification of Underground Service Alert (USA), 811, is required for all planting areas.
- B. Contractor shall carefully examine the civil, as-built, record, and survey drawings to become familiar with the existing underground conditions before digging. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by USA.

- C. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.
- D. Damage to existing work, including utilities, shall be repaired at the contractor's sole expense.

1.18 TEMPORARY UTILITIES

- A. All temporary water, power, piping, wiring, meters, panels and other related appurtenances required between source of supply and point of use shall be provided by the Contractor and coordinated with the Owner's Representative. Existing utilities may be used with the written permission of the owner.

PART 2 – PRODUCTS

2.01 PLANTS: GENERAL

- A. Standards and measurement: Provide plants of quantity, size, genus, species, and variety or cultivars as shown and scheduled in contract documents.
 - 1. Containerized Plants: class size shall conform to ANSI Z60.1 for each size and type of plant. Container stock shall have been grown in specified container size for at least 4 months, but not more than 18 months. Root ball shall be neither under-developed nor over-developed.
 - 2. All plants including the root ball dimensions or container size to trunk caliper ratio shall conform to ANSI Z60.1 "American Standard for Nursery Stock", unless modified by provisions in this specification. When there is a conflict between this specification and ANSI Z60.1, this specification section shall be considered correct.
 - 3. Plants larger than specified may be used if acceptable to the Owner's Representative. Use of such plants shall not increase the contract price. If larger plants are accepted the root ball size shall be in accordance with ANSI Z-60.1. Larger plants may not be acceptable if the resulting root ball cannot be fit into the required planting space.
- B. Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.
- C. Compliance: All trees shall comply with federal and state laws and regulations requiring observation for plant disease, pests, and weeds. Observation certificates, if required by law, shall accompany each shipment of plants.
- D. Plant Quality:
 - 1. General: Provide healthy stock, grown in a nursery and reasonably free of die-back, disease, insects, eggs, bores, and larvae. At the time of planting all plants shall have a root system, stem, and branch form that will not restrict growth, stability and health for the expected life of the plant. Plants shall be healthy with the color, shape, size and distribution of trunk, stems, branches, buds and leaves typical to the plant type specified.
 - 2. Plant quality above the soil line shall comply with branching structure details and the following.
 - a. Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader (requirement does not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars).
 - b. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.
 - c. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that

penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury). Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. An auxiliary stake may be used to maintain a straight leader in the upper half of the tree.

- d. Branches:
 - 1.) Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
 - 2.) Main branches shall be distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.
 - 3.) Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch union.
 - e. Tree Branching structure:
 - 1.) Central Leader: Trees shall have one central leader. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present. All trees are assumed to have one central leader trees unless a different form is specified in the plant list or drawings.
 - 2.) The attachment of the largest branches (scaffold branches) shall be free of included bark.
 - 3.) Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper.
 - f. Grafts: graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.
3. Plant quality at or below the soil line:
- a. Plant roots shall be typical to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Structure details and the following:
 - 1.) The roots shall be reasonably free of scrapes, broken or split wood.
 - 2.) The root system shall be reasonably free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high-quality root system are not considered injuries.
 - 3.) A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species.
 - 4.) The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.
 - 5.) The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots (angled greater than 90 degrees).
 - 6.) At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

2.02 PLANTING SOIL

- A. Planting Soil shall be native or imported topsoil. Planting soil shall be fertile, friable soil containing less than 5% by volume of subsoil, refuse, rocks, clay (heavy, sticky or stiff), sticks, brush, or litter. Soil shall not contain weeds or seeds in quantities causing noticeable

weed growth in planting areas, or any material deleterious to plant growth. Obtain and submit a two-gallon soil sample and agronomic testing results for all proposed imported soils. Imported topsoil shall meet the following criteria:

1. Soil texture: USDA loam, sandy clay loam or sandy loam with clay content between 15 and 25%. And a combined clay/silt content of no more than 55%.
2. pH value shall be between 5.5 and 7.0.
3. Percent organic matter (OM): 2.0-5.0%, by dry weight.
1. Soluble salt level: Less than 2 mmho/cm.

2.03 SOIL AMENDMENTS

- A. Compost: shall be blended and ground leaf, wood and other plant-based material, composted for a minimum of 9 months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material. Compost shall be commercially prepared and meet US Compost Council STA/TMECC criteria. Compost shall comply with the following parameters:
 1. pH: 5.5 - 7
 2. Soil Salt (electrical conductivity): maximum 3 dS/m (mmhos/cm).
 3. Moisture content%, wet weight basis: 30-60.
 4. Particle size, dry weight basis: 98 percent passing through 3/4 inch screen.
 5. Stability carbon dioxide evolution rate: mg CO₂ -C/g OM/day<2.
 6. Solvita maturity test:> 6
 7. Physical contaminants, percent dry weight: <1percent.
 8. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40 CFR & 503.13, Tables 1 and 3 levels.
 9. Biological contaminants meet or exceed US EPA Class A standard 40 CFR & 503.32 (a) level requirements.
- B. Gypsum: Agricultural grade product containing 98 percent minimum calcium sulfate.
- C. Iron Sulfate: 20 percent iron (expressed as metallic iron), derived from ferric and ferrous sulfate, 10 percent sulfur (expressed as elemental).
- D. Fertilizer: pelleted or granular form, mixed by a commercial fertilizer supplier, consisting of the following percentages by weight, if not otherwise recommended by agronomic testing:
 1. 16 percent nitrogen
 2. 6 percent phosphoric acid
 3. 8 percent potash
- E. Plant Fertilizer Tablets: slow-release as manufactured by Agriform, Best, or equal, with the following percentages by weight:
 1. 20 percent nitrogen
 2. 10 percent phosphoric acid
 3. 5 percent potash
 4. 2.6 percent combined calcium
 5. 1.6 percent combined sulfur
 6. 0.35 percent iron (elemental)

2.04 MULCH

- A. Mulch shall be "walk-on" grade, coarse, ground, from Douglas Fir, White Fir, or Red Fir. The size range shall have a minimum (less than 25% or less of volume) of fine particles 3/8 inch or less in size, and a maximum size of individual pieces (largest 20% or less of volume) shall be approximately 1 to 1-1/2 inch in diameter and maximum length of approximately 6 inches. Pieces larger than 5 inches long visible at the surface of the mulch shall be removed.

1. Acceptable products: SunUp Shredded Cedar, Redi-gro "Red Fir Walk-On Bark," K&M Forest Products "Walk-On Bark," or equal.
 2. Submit supplier's product specification data sheet and a one gallon sample for approval.
- B. After final walkthrough, but prior to turnover, apply polymer binder to bark mulch.
1. Acceptable products: "BarkBinder" by Technisoil Global, Inc, "Mulch-Lock" by United Industries Corporation, or equal.
 2. Submit supplier's product specification data sheet for approval.
 3. Follow all manufacturer's recommendations and requirements.
- 2.05 TREE STAKING AND GUYING MATERIAL
- A. Tree guying to be flat woven polypropylene material, 3/4 inch wide, and 900 lb. break strength, color: green. ArborTie, manufactured by Deep Root Partners, L.P., or equal.
- D. Tree ties: vinyl or nylon-reinforced vinyl, with UV inhibitors; Cinch-Tie by VIT, Super Tree Tie by Arthur Enterprises, or equal.
- B. Stakes shall be lodge pole stakes free of knots, minimum 2-inch diameter, lengths appropriate to the size of plant as required to adequately support the plant.
- 2.06 ROOT BARRIERS
- A. 18" or 24" deep (as indicated on drawings) linear polypropylene panels or roll, with stiffening ribs; UB-18-2/UB24-2 by DeepRoot Green Infrastructure LLC, EP-series by NDS, or equal.
- 2.07 SAND
- A. Clean, washed silica
- 2.08 DRAINAGE ROCK
- A. Crushed, angular rock, 1/4 to 1 inch in diameter, hard, durable, uniform, and free of any deleterious material.

PART 3 – EXECUTION

- 3.01 SITE EXAMINATION
- A. Examine the surface grades and soil conditions to confirm rough grading and all prior work is completed. Notify the Owner's Representative in writing of any unsatisfactory conditions. Beginning work constitutes acceptance of site conditions.
- 3.02 COORDINATION WITH PROJECT WORK
- A. The Contractor shall coordinate with all other trades and work that may impact this work.
- B. Coordinate the relocation of any irrigation lines, heads, or other items that conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.
- 3.03 LAYOUT AND PLANTING SEQUENCE
- A. General: Plant trees before other plants are installed. Relative positions of all plants and trees are subject to approval of the Owner's Representative. Make adjustments as required by the Owner's Representative including relocating previously installed plants.
- 3.04 PLANTING SOIL PREPARATION
- A. Prior to installing irrigation, fracture (rip) the top 18-24" of soil. Remove all stones, debris, organic matter, etc. larger than 1" in diameter that is brought to the surface.
- B. After approximate finish grades have been established, amend planting areas by tilling into the top 6-8" of soil amendments indicated by soils agronomic testing, local requirements, or

the following, whichever is most stringent:

1. Compost: 4 cubic yards per 1,000 square feet
2. Fertilizer: 15 lbs per 1,000 square feet
3. Gypsum: 50 lbs per 1,000 square feet
4. Iron Sulfate: 2 lbs per 1,000 square feet

3.05 PLANTING SOIL PROTECTION

- A. Protect soil from compaction during the delivery of plants to the planting locations, digging of planting holes and installing plants.
 1. Deliver and plant trees that require the use of heavy mechanized equipment (larger than 48" box) prior to final soil preparation and tilling. Where possible, restrict the driving lanes to one area instead of driving over and compacting a large area of soil. Where soil has been driven over, till soil to a depth of 6 inches, and ensure compaction is not above 85% relative density with 18 inches of finish grade.

3.06 ROOT BARRIER INSTALLATION

- A. Place root barrier flush and tight to back of adjacent work, plumb and straight, with top edge 1/2 inch above finish grade, and 1/2 to 1 inch below adjacent work.
- B. Roll stock shall be unrolled and straightened prior to installation. Joints shall be lapped 12" minimum and welded with manufacturer-specified solvent.
- C. "Surround" type configurations encircling plants or encroaching on planting area are not allowed and will be rejected.

3.07 PLANT DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind or extremes of heat and cold temperatures. If planting is delayed more than 24 hours after delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during the shipping and storage period.
 1. All plant materials must be available for observation prior to planting.
 2. Maintain soil moisture above the wilting point and below field capacity. Measure soil moisture using a soil moisture meter.
- B. Do not deliver more plants than can be stored on site. Provide a suitable storage and staging area for plants, materials, and equipment.
 1. The Owner's Representative shall approve the duration, method, and location of plant storage.
- C. Immediately prior to transporting, treat all plant material in full leaf with an anti-desiccant, following manufacturer's instructions. Provide protective covering over all plants during transporting.

3.08 PLANTING CONDITIONS

- A. Adverse weather conditions: No planting shall take place during extremely hot, dry, windy, or freezing weather.
- B. Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting, shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

Soil type	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%

Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1. Volumetric soil moisture shall be measured with a digital moisture meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent.
2. Verify soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.09 PLANTING HOLE PREPARATION

- A. Excavation: Using hand tools or tracked mini-excavator, excavate the planting hole to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball to the size indicated on the drawings, or at least twice the diameter of the root ball, whichever is greater.
 1. For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 8 inches, over a distance of more than 10 feet from each tree, or 5 feet from each shrub, the soil around the root ball shall be loosened as follows:
 - a. The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
 - b. Loosening is defined as digging into the soil and turning the soil to reduce the compaction. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.
 2. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
 3. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
 4. If motorized equipment is used to deliver plants to the planting area over exposed planting areas or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.
- B. Where soil has been prepared to a depth deeper than the root ball depth, compact the soil under the root ball using a mechanical tamper to assure a firm bedding for the root ball. If there is more than 12 inches of planting soil under the root ball excavate and tamp the planting soil in lifts not to exceed 12 inches.
- C. Percolation testing: Test holes for 1 out of 5 trees planted, and at least one test of tree or shrub hole in every bioswale or stormwater feature. Fill holes with water and verify drainage within 24 hours. Where drainage does not occur, auger a minimum 1 foot diameter by 8 foot deep hole and backfill with drainage rock.
- D. Hardpan: where encountered, use powered equipment to break through the impervious layer at each tree and shrub location. Remove hardpan in an area at least 18" wider than the diameter of the plant. Backfill with Planting Soil.

3.10 PLANTING TREES AND SHRUBS

- A. Observe each plant after delivery and prior to installation for damage of other characteristics that may cause rejection of the plant. Replace such plants.
- B. No more plants shall be distributed than can be planted and watered on the same day.
- C. Remove containers carefully to avoid damage to the root system. Do not lift or handle plants by the tops, stems, or trunks. Do not mar or damage the bark of any plant.
- D. Observe the root system of each plant at planting to confirm that the roots meet the requirements for plant root quality. The Contractor shall perform all modifications to the root

system required by the Owner's Representative to meet these quality standards.

1. Modifications, at the time of planting, to meet the specifications for the depth of the root collar and removal of stem girdling roots and circling roots may make the plant unstable or stress the plant to the point that the Owner's Representative may choose to reject the plant rather than permitting the modification.
 2. Any modifications required by the Owner's Representative to make the root system conform to the plant quality standards outlined in Part 2 Products: Plants General: Quality, or other related requirements shall not be considered as grounds to modify or void the plant warranty.
- E. Container and Boxed Root Ball root pruning: remove all circling, descending, and matter roots from the outer surfaces of all plants in containers and boxes, including the top, sides, and bottom of the root ball. Slice root mass at four locations around the perimeter of the root ball. Where required for 15 gallon or larger plants, shave root ball to remove 1/2 inch to 2 inches of root mat to eliminate all root segments that are not growing approximately radial to the trunk. Shaving shall be performed using saws, knives, sharp shovels or other suitable equipment that is capable of making clean cuts on the roots.
- F. Set top outer edge of the root ball at the average elevation of the proposed finish. Set the plant plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball. Set the plant in the same orientation as it was grown, however, the Owner's Representative may request that plants orientation be rotated when planted based on the form of the plant.
- G. Backfill the space around the root ball with the material excavated for the planting hole. Tamp Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6") lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. DO NOT over compact the backfill or use mechanical or pneumatic tamping equipment. Over compaction shall be defined as greater than 85% relative density.
1. When the planting hole has been backfilled to three quarters of its depth, pour water around the rootball, and allow to soak in to settle the soil without flooding. Place Plant Fertilizer Tablets around rootball as indicated on the drawings. Air pockets shall be eliminated and backfill continued until the Planting Soil is at finish grade.
- H. Where indicated on the drawings, build and tamp a berm of Planting Soil around the outside of the root ball to retain water.

3.11 TREE STAKING AND GUYING

- A. Maintain all plants in a plumb position throughout the Establishment Period. Straighten all trees that move out of plumb including those not staked. Plants to be straightened shall be excavated and the root ball moved to a plumb position, and then re-backfilled. Do not straighten plants by pulling the trunk.
- B. Staking and guy trees with materials specified. Tie guys with a slack loop to prevent girdling. Refer to manufacturer's recommendations and planting details for installation.

3.12 PLANTING GROUNDCOVER, PERENNIALS, ORNAMENTAL GRASS, AND ANNUALS

- A. Preparation:
 1. Ensure that soil moisture is within the required levels prior to planting. Irrigation, if required, shall be applied at least 12 hours prior to planting to avoid planting in muddy soils. Ensure that soil grades in the planting areas are smooth and as shown on the plans. Schedule the planting to occur prior to application of the mulch. If the area is already mulched, pull the mulch from around the hole and plant into the soil. Do not plant the root system in the mulch. Pull mulch back so it is not on the root ball surface.

B. Installation:

1. Plants shall be planted in even, triangularly spaced rows, at the intervals called out for on the drawings, unless otherwise noted. The first row of Annual flower plants shall be 8 inches from the planting area edge unless otherwise directed.
Dig planting holes sufficiently large enough to insert the root system without deforming the roots. Set the top of the root system at the grade of the soil. Press soil to bring the root system in contact with the soil. Spread any excess soil around in the spaces between plants.

3.13 PRE-EMERGENT

- A. Apply pre-emergent to all planting areas after planting and prior to mulch. Use Dimension or equal and follow all manufacturer's directions. Do not apply to sensitive plants, bare-rooted plants, plugs, stolons, or seeded areas.

3.14 PRUNING TREES AND SHRUBS

- A. Do not allow plants to be topped, pruned, or trimmed prior to delivery.
- B. Prune plants to address structural deficiencies or as directed by the Owner's Representative. Follow recommendations within ANSI A 300. Except for plants specified as multi-stemmed or as otherwise instructed by the Owner's Representative, preserve or create a central leader.
- C. All pruning shall be performed by a person experienced in structural tree pruning. Pruning shall be done with clean, sharp tools. No tree paint or sealants shall be used.
- D. Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic lift to gain access to the top of the tree. Do not climb in newly planted trees. Small trees can be structurally pruned by laying them over before planting.
- E. Remove and replace excessively pruned or malformed stock resulting from improper pruning.

3.15 PLANTING AREA FINISHING

- A. After planting, smooth out all grades between plants before mulching. Taper finish grade at all planting area edges as shown in the drawings.

3.16 MULCH

- A. Apply mulch to a depth of 3 inches after settlement, covering the entire planting area. Install no more than 1 inch of mulch over the top of the root balls of all plants. Taper mulch when abutting pavement.
- B. For trees planted in lawn areas the mulch shall extend to a 5 foot radius around the tree or to the extent indicated on the plans.
- C. Lift all leaves, stems, and other portions of plants out of the mulch if covered.

3.17 WATERING

- A. The Contractor shall ensure that adequate water is provided to all plants from installation until the date of Substantial Completion, and through the Establishment Period (if existing). The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.
- B. Immediately after installation of all planting, hand water root balls of all plants, and sodded areas, to ensure that the roots and root balls have moisture above wilt point and below field capacity.

3.18 CLEAN-UP

- A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the

site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting areas and that all tags, and markers are removed from the site. After observation by Owner's Representative, remove all nursery plant tags and ribbons.
- C. Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.
- D. Remove and dispose of all excess planting soil, subsoil, mulch, plants, packaging, and other material.

3.19 PROTECTION DURING CONSTRUCTION

- A. The Contractor shall protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection until Final Acceptance.
- B. Damage done by the Contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including roots, trunk or branches of large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the Contractor at no expense to the Owner. The Owner's Representative shall determine when such cleaning, replacement or repair is satisfactory.

3.20 SUBSTANTIAL COMPLETION / ESTABLISHMENT PERIOD

- A. Upon written notice from the Contractor, the Owner's Representative shall observe the work to determine if Landscape Installation is substantially complete.
 1. Notification shall be at least 7 days prior to the observation.
 2. The substantial completion review will not occur until all sodded, seeded, or hydroseeded turf areas demonstrate a full, even, vigorous stand of grass, or after the second mowing, whichever is later.
- B. The Establishment Period begins at date of written notification of substantial completion from the Owner's Representative. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.
- C. The Establishment Period consists of plant and other maintenance as described in Section 32 98 00 – Landscape Maintenance. Any day of improper maintenance, as determined by the Owner's Representative, will extend the Establishment period.

3.21 PROJECT ACCEPTANCE / END OF WARRANTY OBSERVATION

- A. At the end of the Establishment Period, upon written notice from the contractor, the Owner's Representative shall observe the work to verify that all provisions of the contract are complete, and the work is satisfactory.
 1. Notification shall be at least 7 days prior to the date the contractor is requesting the observation.
 2. If the work is satisfactory, the Establishment Period will end on the date of the final observation.
 3. If the work is deemed unsatisfactory, the Establishment Period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner's Representative.
 4. If the work fails to pass final observation, a subsequent observation must be scheduled.

The cost to the Owner for subsequent observations will be charged to the Contractor at the prevailing hourly rate of the Owner's Representative.

- B. At the end of the Warranty Period, the Owner's Representative shall again observe the work to verify that the Landscape Planting is healthy and satisfactory.

END OF SECTION 32 90 00

SECTION 32 92 00

NATIVE GRASSES

PART 1 - GENERAL

1.01 CONDITIONS

- A. The general provisions of the contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this section.

1.02 SCOPE OF WORK

- A. Furnish all labor, material, equipment and services necessary to provide all landscape work, complete and in place, as indicated on Drawings and specified herein.
- B. Work specified in this Section, but is not limited to the following:
 - 1. Soil preparation
 - 2. Weed Control
 - 3. Hydroseeding
 - 4. Clean-up

1.03 QUALITY ASSURANCE

- A. Source Quality Control
 - 1. Native Grasses shall be from the same ecotype as the project.
 - 2. Hydroseeded native grasses shall exhibit a uniform growth, in good health, free of noxious or invasive weeds, with viable seed production (season permitting), competitiveness against non-native species at the time of final acceptance, and demonstrating at least 75% coverage at the end of the maintenance period (as measured by canopy coverage within a randomly selected one yard by one yard plot, one plot per 12,000 sf of hydroseeded area). Hydroseeded native grasses shall demonstrate at least 50% coverage at the end of the warranty period.
 - 3. Plugged native grasses shall be 95% viable and vigorously growing at the end of the first growing season (onset of summer, if planted in late fall or winter). Plugged native grasses shall be 90% viable and vigorously growing at the end of the warranty period.
- B. Acceptance of seed:
 - 1. Seed shall be tested according to the Association of Official Seed Analysts, International Seed Testing Association, and the Federal Seed Act standards. Tested seed shall be accompanied by a certificate of analysis furnished by a certified testing laboratory. All seed shall be subject to inspection and concurrence by the Contractor before the subcontractor is authorized to proceed with the seeding operation.
 - 2. Certify as tested the following for each individual seed species, variety, or mix:
 - a. Purity and Germination: Before seed is used, retest for germination all seed stored over six months from the date of the original acceptance test, and resubmit the results for inspection.
 - b. Prohibited Noxious Weed Seed: Seed shall contain no federal- or state-listed prohibited noxious weed seed (an amount within the tolerance of zero percent) as determined by a standard purity test.

- c. Restricted Noxious Weed Seed: Seed shall contain no more than 40 seeds per pound of any. Single species or 150 seeds per pound of all species combined, of restricted noxious weed seed. Restricted noxious weed seed is considered to be component of other crop and weed seed with limitations specified.
 - d. Weed Seed: Seed shall contain no more than 1 percent by weight, of weed seed of other crops and plant species as determined by standard purity tests.
3. Information regarding the seed mixture shall be provided by the seed vendor on each standard sealed container label. The labels shall include the following information:
- a. Seed mixture name
 - b. Lot number
 - c. Total net weight and PLS weight of each seed type
 - d. Percentages of purity and germination
 - e. Seed coverage, in acres, on a PLS basis
 - f. Percentage of maximum weed seed content clearly marked for each seed type.
- C. The Owner's Representative shall be the sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within fifteen (15) days of written notification.

1.04 SUBMITTALS

- A. Contractor shall submit the proposed source, ecotype, and demonstrate availability of the proposed seed.
- B. Submit a complete list of equipment, materials, or processes specified or proposed. Include product information sheets if available.
- C. Contractor shall submit a sample of all supplied materials accompanied by analytical data from an approved laboratory source illustrating compliance of bearing the manufacturer's guaranteed analysis.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery
 - 1. The Contractor, shall provide receipts, delivery tickets, load tickets, etc. of all items delivered to the job site to verify products and total quantities.
 - 2. Deliver fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name trademark, and conformance to State Law.

1.06 JOB CONDITIONS

- A. Install grasses after irrigation system is operable and has been accepted by the Owner (see Section 32 84 00 Landscape Irrigation).
- B. The contractor is responsible for ensuring sufficient water is applied to newly installed native grass areas to prevent any actual or apparent reduction in growth, drought stress, or other limits on plant growth due to insufficient water. Contractor shall monitor weather reports, and if needed, apply additional water without harming new installed material. This may include, but is not limited to, use of water trucks, manual watering via temporary hoses, and/or extension of the temporary irrigation system beyond what is shown in the drawings.

- C. Protect work and materials from damage due to construction operations by other contractors and trades and by vandalism. Maintain protection during installation and maintenance period.
- D. Native grass planting shall be performed during the following timeframe: October 1 to February 1, with adequate soil moisture present. Hydroseeding operations shall not take place if any of the following conditions are predicted in the next 24 hours:
 1. Temperatures above 80°F.
 2. Temperatures below 35°F.
 3. Windspeeds at or above 20 mph.
 4. Rainfall greater than one tenth of an inch

1.07 SAMPLES AND TESTS

- A. The Owner reserves the right to take and analyze samples of materials for conformity to specifications. The Contractor shall furnish samples upon request by the Owner's Representative. Rejected materials shall be removed from the site at Contractor's expense. Cost of testing of materials not meeting specifications shall be paid by Contractor.
- B. Soils Fertility (Agronomic) Testing: To ensure a suitable growing medium for plants, employ services of a certified agronomic soils testing laboratory to perform confirmatory soil testing at specified locations. Contractor is to provide documented locations for review by the Owner's Representative for approval before testing can proceed. Contractor is responsible for agronomic soil testing costs.
 1. Perform soil sampling of prepared planting soil once fine grading, weed control, soil amendments have been completed, and prior to planting.
 2. Soil test recommendations may take precedence over soil amendment procedures specified in this or other sections, if determined by the Owner's representative (note that soil amendment recommendations made for general landscape planting may not be applicable to establishment of native grasses, and applicability shall be determined by the Owner's representative).
 3. Take samples of site soil at following depths and quantity:
 - a. Areas for tree planting: twelve inches, 2 locations
 - b. Hydroseeded or plugged grass areas: six inches, 4 locations.
 4. Provide the following at each soil test location:
 - a. Chemical analysis report of each soil sample location to include the following:
 - (i) Percentage of organic matter.
 - (ii) salinity.
 - (iii) PH.
 - (iv) Mineral nutrients, including concentrations of nitrogen, phosphorus, potassium, calcium, and magnesium.
 - (v) Potential hazards of impediments to plant growth from salinity; sodium, boron, impaired soil structure or drainage.

- b. Request testing for fertility and suitability analysis with written recommendations for soil amendment application rates.
- c. Soil percolation rates.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacturer's guaranteed analysis.

2.02 MATERIALS

A. Soil Conditioner

- 1. Gro-Power Plus (no known equal): Humus (bacteria included) based fertilizer and soil conditioner with soil penetrant shall consist of the following percents by weight:
 - a. 5% nitrogen
 - b. 3% phosphoric acid
 - c. 1% potash
 - d. 50% humus
 - e. 15% humic acids

B. Organic Amendment

- 1. Per Section 32 90 00 Landscape Installation.

C. Soil Fertilizer

- 1. Organic, non-petroleum based NPK fertilizer which contains the following percentages by weight, or equivalent:
 - a. 7% nitrogen
 - b. 2% phosphoric acid
 - c. 6% potash

D. Hydroslurry Fertilizer

- 1. Organic (min. 93%), non-petroleum based NPK (nitrogen, phosphoric acid, potash) fertilizer which contains the following percentages by weight, or equivalent:
 - a. 7%-2%-1% (Biosol Forte as manufactured by Rocky Mountain Bio Products or eq.)
 - b. 3%-7%-2% (Sustane 3-7-2 as manufactured by Sustane or equal)
 - c. 7%-2%-3% (Pure 'N' Natural as manufactured by Gro-Power or equal)

E. Wood Cellulose Fiber Mulch (Hydromulching)

- 1. Mulch shall be specially prepared wood cellulose fibers with no growth or germination inhibiting factors, and dyed green to facilitate visual metering during application. Wood cellulose fiber shall have additional characteristics of dispersing rapidly in water to form homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit.

2. Wood cellulose fiber mulch shall be supplied, compressed in packages containing 50 pounds of material having an equilibrium air dry moisture content at time of manufacture of 12%, plus or minus 2.
- F. Binders
1. Organic, natural tackifier derived from ground Psyllium.
 2. Organic, natural polysaccharide derived from Guar gum. (Verify application rates with manufacturer and include in submitted substitution request for approval: application rates listed below are for Psyllium-based products)
- G. Fungicide
1. "Subdue" (Ciba-Geigy) or equal.
- H. Herbicides
1. Per Section 32 90 00 Landscape Installation.
- I. Mycorrhizal Inoculant
1. Granular formulation of endomycorrhizal species suitable for incorporation with hydroslurry mix, minimum of 25,000 spores per pound.
 - a. MycoApply "Endo"
 - b. Bio Organics "Micronized Endomyorrhizal Inoculant (BEIM)"
 - c. Or equal.

2.03 PLANT MATERIAL

- A. Plant Mixes
1. See Plans for Slope Hydroseed Mix and Basin Bottom Hydroseed Mix
 2. Seed shall be weed free, fresh, re-cleaned, Grade A, new crop consisting of the percentages of mix as specified. Seed shall be labeled in accordance with the U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act presently in effect.
 3. Seed shall be provided from and mixed by a certified dealer. Seed mixture shall be labeled with manufacturer's guaranteed analysis, germination rate and purity rate.

2.04 MULCH

- A. Mulch shall be as specified in 32 90 00 Landscape Planting.

2.05 EQUIPMENT

- A. Hydro-Seeder
1. Equipment used for application of slurry shall be a commercial-type Hydro-Seeder and have a built-in agitation system with an operation capacity sufficient to agitate, suspend and homogeneously mix slurry.
 2. Tank capacity shall be a minimum of 1,500 gallons and shall be mounted on a truck to allow access to the site.
 3. Distribution Lines: Large enough to prevent stoppage and allow for even distribution of slurry over the site.

4. The pump shall be able to generate 150 psi at the nozzle.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Per Section 32 90 00 Landscape Planting.

3.02 SOIL CLEANUP AND PREPARATION

- A. Per Section 32 90 00 Landscape Planting.

3.03 INSTALLATION

- A. Pre-plant Weed Control per Section 32 90 00 Landscape Planting.
- B. Hydroseed:
 1. If Psyllium-based tackifier is used, pre-moisten the application area.
 2. Apply Hydromulch in two applications:
 - a. Apply all seed, fertilizer, mycorrhizal inoculum, and 25% of hydrostraw fiber.
 - b. Apply 75% of hydrostraw fiber and 100% of hydromulch tackifier.
- C. Watering after installation:
 1. Hand water seeds after installation, thoroughly wet the surrounding area without allowing soil to become saturated or standing water to form. Do not allow seeds to dry prior to watering.
 2. Maintain optimum moisture to sustain germination and plant growth, tapering water off to emulate natural conditions as soon as possible.

3.04 OBSERVATION SCHEDULE

- A. Per Section 32 90 00 Landscape Planting

3.05 CLEAN UP

- A. Per Section 32 90 00 Landscape Planting

3.06 MAINTENANCE

- A. Per Section 32 90 00 Landscape Planting

3.07 REPLACEMENT:

- A. Re-apply hydroseed to all dead or unhealthy strands of grass with equal material as directed by the Owner's Representative, and at minimum the following times:
 - a. Substantial Completion or Final Landscape Inspection prior to the maintenance period
 - b. End of the maintenance period
 - c. End of the warranty period
- B. Per Section 32 90 00 Landscape Planting

END OF SECTION 32 92 00

SECTION 32 98 00

LANDSCAPE MAINTENANCE

PART 1 – GENERAL

1.01 SUMMARY OF WORK

- A. During the Establishment Period, or until project acceptance, whichever is longer, provide all maintenance to keep plants in a healthy state and the planting areas clean and neat. The Establishment Period will be as a minimum of **60 days**, or until the project is accepted. Any day of improper maintenance, as determined by the Owner's Representative, will extend the Establishment period.

1.02 QUALITY ASSURANCE:

- A. All work shall be undertaken by trained landscape maintenance workers under the supervision of a foreman with a minimum of 2 years experience supervising commercial landscape maintenance crews.
- B. All chemical and fertilizer applications shall be made by licensed applicators for the type of chemicals to be used. All work and chemical use shall comply with all applicable local, state, and federal requirements.

1.03 ACCESS AND SAFETY

- A. Assure that hoses and watering equipment and other maintenance equipment does not block paths or be placed in a manner that may create tripping hazards. Use standard safety warning barriers and other procedures to maintain the site in a safe manner for visitors at all times.
- B. All workers shall wear required safety equipment and apparel appropriate for the tasks being undertaken.
- C. The Contractor shall not store maintenance equipment at the site at times when they are not in use unless authorized in writing by the Owner's Representative.
- D. Maintenance vehicles shall not park on the site including walks and lawn areas at any time without the Owner's Representative's written permission.

1.04 RECORDS

- A. Maintain a detailed log of all maintenance activities including types of tasks, date of task, types and quantities of materials and products used, watering times and amounts, and number of each crew. Submit logs to the Owner's Representative monthly.
- B. Meet with the Owner's Representative at final acceptance to formally transfer the responsibilities of maintenance to the Owner's Representative. Provide all information on past maintenance activities and provide a list of critical tasks that will be needed over the next 12 months. Provide all maintenance logs and soil test data not previously submitted.
- C. Contractor's supervisor shall be available for a minimum of three months after the end of the Establishment Period to answer questions about past maintenance.

1.05 REPAIR

- A. Repairs shall be made within 24 hours of written notification by Owner's Representative. Repairs due to defective materials, improper work, or regular use shall be made at no cost to the owner.
- B. Repair of damage by visitors and events beyond normal use and wear, vandalism, or natural disasters, are not part of this maintenance. The Owner's Representative may request that the Contractor repair damage from such events at an additional cost. All additional work shall be

approved in advance by the Owner's Representative.

PART 2 – PRODUCTS

2.01 GENERAL

- A. As specified in Section 32 90 00 – Landscape Planting.

PART 3 – EXECUTION

3.01 WATERING

- A. Provide all water required to keep soil within and around the root balls at optimum moisture content for plant growth.
 - 1. Maintain Irrigation system and equipment, including a visual observation, by station, at least monthly. Adjust programming as required to provide optimum water, and to minimize overspray, runoff, or saturation below the root zone.
 - 2. Hand-water as required. Use a hose-end diffuser to prevent plant damage and soil disturbance.
 - 3. Monitor soil moisture to provide sufficient water. Check soil moisture and root ball moisture with a soil moisture meter on a regular basis and record moisture readings. Do not over water.

3.02 FERTILIZATION

- A. Soil nutrient levels: Take a minimum of 4 soil samples from around the site in the spring and fall and have them tested by an accredited agronomic soil testing lab for chemical composition of plant required nutrients, pH, salt and % organic matter. Test results shall include laboratory recommendations for nutrient applications. Apply fertilizers at rates recommended by the soil test.
 - 1. Make any other soil test and/or plant tissue test that may be indicated by plant conditions that may not be related to soil nutrient levels such as soil contaminated by other chemicals or lack of chemical uptake by the plant.

3.03 PRUNING

- A. Remove cross-over branches, shorten or remove developing co-dominant leaders, dead wood and winter-damaged branches.
- B. Unless directed by the Owner's Representative, or where a formal hedge is clearly indicated by plant type and spacing, do not shear plants.
- C. In no case shall pruning result in individually boxed or balled plantings. Adjacent plants of the same species shall be allowed to grow together. Head-back or pinch buds to encourage lateral growth filling in planter areas.

3.04 REPLACEMENT

- A. Replace all plants that are defective or unsatisfactory as described in Section 32 90 00 as soon as the plant decline is obvious and in suitable weather and season for planting as outlined in above sections. Plants that become defective during the maintenance period shall be covered and replaced under the warranty provisions.
- B. Replace all damaged materials with same materials as originally installed.

3.05 MULCHING

- A. Prior to final acceptance, top-off all mulched areas to assure complete coverage at an average depth of 3 inches, but do not over mulch. At no time shall the overall mulch thickness be greater than 4 inches. Do not re-apply mulch within 6 inches of the trunks or stems of any plants. Replacement mulch shall meet the requirements of the original approved material.

Mulch shall be no more than one inch on top of the root ball surface.

3.06 GENERAL

- A. Mowing: mow all turf areas once per week after establishment. From December through February, mowing frequency may be reduced to twice per month if warranted. Mow height shall maximize leaf area while maintaining turf function (ornamental, casual use, or sports use)
- B. Edging: trim turf area edges with a mechanical edge trimmer, maintaining a perpendicular edge between turf and adjacent materials. Do not over-cut edges. Trimming shall occur not less than every other week. Trim all groundcovers and other plants to maintain growth within planting areas.
- C. Debris removal: Remove trash, fallen leaves, spent flowers, fruit and plant part accumulations from beds and paved surfaces. Maintain all surface water drains free of debris. Debris removal shall be undertaken at each visit. Legally dispose of all debris off-site unless otherwise directed by Owner's representative.
- D. Settlement: Reset any plants that have settled or are leaning as soon as the condition is noticed. Repair any settlement in finished grades.
- E. Guying and staking: Maintain plant guys in a taught position. If left during maintenance, Remove all nursery stakes prior to final acceptance unless otherwise directed by Owner's Representative.
- F. Weed control: Keep all planting areas free of weeds. Hand-remove all weeds and any plants that do not appear on the planting plan. Chemical weed control is permitted only with the approval of the Owner's Representative. Schedule weeding as needed but not less than 8 times per year.
- G. Plant pest control: Maintain disease, insects and other pests at manageable levels. Manageable levels shall be defined as damage to plants that may be noticeable to a professional but not to the average person. Use least invasive methods to control plant disease and insect outbreaks.
 - 1. The Owner's Representative must approve all chemical pesticide applications in advance.

END OF SECTION 32 98 00

SECTION 02510 (33 1000) - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site water piping and fittings including domestic potable waterline and fire protection system supply waterline, valves, and fire hydrants.

B. Related Requirements:

1. Section 02300 – Earthwork: Trenching, backfill, and compaction for utilities.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

1. ASME B 16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. ASTM International (ASTM):

1. ASTM B88 - Seamless Copper Water Tube.
2. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
4. ASTM D2564 - Poly (Vinyl Chloride) (PVC) Solvent Cement.
5. ASTM D2672 - Poly (Vinyl Chloride) (PVC) Integrally Molded Bell Ends For Solvent - Cemented Pipe Joints.
6. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
7. ASTM F477 - Elastomeric Gaskets And Lubricant.
8. ASTM F656 - Poly (Vinyl Chloride) (PVC) Cement Primer.

D. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and other Liquids.
3. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Watersupply Service.
4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
5. AWWA C153 - Ductile-Iron Compact Fittings for Water Service.
6. AWWA C504 - Rubber-Seated Butterfly Valves.
7. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
8. AWWA C550 - Protective Interior Coatings for Valves And Hydrants.
9. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
10. AWWA C605 - Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
11. AWWA C651 - Disinfecting Water Mains.
12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water Distribution.

E. National Fire Protection Association (NFPA):

1. NFPA 24 – Installation of Private Fire Service Mains and Their Appurtenances

F. State of California Water Code

G. City of Stockton Standard Specifications

1.3 QUALITY ASSURANCE

- A. Products, where marked for compliance with code or test standards, shall also mark specific standard as required in the Contract Documents.
- B. Perform installation in accordance with utility company or municipality requirements.
- C. Valves: Mark manufacturer's name and pressure rating on valve body.
- D. Perform disinfection of potable lines in accordance with AWWA C651

1.4 SUBMITTALS

- A. Furnish 1 copy of results of meter test and hydrostatic pressure test to Owner, Owners Civil Engineering Consultant (CEC), and utility company upon completion of water distribution backfilling operations.
- B. Project Record Documents:
 - 1. Disinfection report: Record the following:
 - a. Type and form of disinfectant used.
 - b. Date and time disinfectant injection start and time of completion.
 - c. Test locations.
 - d. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - e. Date and time of flushing start and completion.
 - f. Disinfectant residual after flushing in ppm for each outlet tested.
 - 2. Bacteriological report: Record the following:
 - a. Date issued, project name, testing laboratory name, address, and telephone number.
 - b. Time and date of water sample collection.
 - c. Name of person collecting samples.
 - d. Test locations.
 - e. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - f. Coliform bacteria test results for each outlet tested.
 - g. Certification that water conforms, or fails to conform, to bacterial standards.
 - h. Bacteriologist's signature and authority.
 - 3. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations. Prepare and provide any record drawings to the utility company or municipality.
 - 4. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

PART 2 - PRODUCTS

2.1 PIPE

- A. Pipe sizes 3-inches and smaller for installation below grade and outside building shall comply with the following:
 - 1. Seamless Copper Tubing: Type "K" soft copper, ASTM B88.
 - a. Fittings: Wrought copper (95-5 Tin Antimony solder joint), ASME B 16.22.
 - 2. Ultra High Molecular Weight (UHMW) P.E. 3406, P.E. 3408, CS 255-63, Polyethylene as manufactured by ADS or an approved equal in one (1) inch iron pipe sizes only. Plastic pipe larger than one (1) inch and up to and including two (2) inch iron pipe sizes shall be PB 2110 Polybutylene. Connection of plastic pipe shall be made using Mueller 110 compression connections or approved equal.
- B. Pipe sizes 4 to 16 inches for installation below grade and outside building shall comply with one or combination of following:

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1. Ductile Iron Water Pipe: ANSI A21.51/AWWA C151, Pressure class 350 (4-12") Pressure Class 250 (14-16").
 - a. Fittings: Either rubber gasket, mechanical, flanged or push-on joint, ANSI A21.10/AWWA C110, and unless otherwise specified, the internal surfaces of ductile iron water pipe and fittings shall be lined with a uniform thickness of cement mortar then sealed with a bituminous coating in accordance with ANSI A21.4/AWWA C104. The outside surfaces of ductile iron pipe and fittings for general use shall be coated with a bituminous coating 1 mil (0.0254mm) thick in accordance with ANSI A21.6 or ANSI A21.51.
 - 1) Rubber gasket push-on joint, ASNI A21.11/AWWA C111
 - 2) Mechanical joint, ANSI A21.11/AWWA C111
 - 3) Flanged joint, ANSI B16.1, B.16.2 and A21.10/AWWA C110
 - 4) Flanged joint (threaded flanges), ANSI B2.1
2. Polyvinyl Chloride (PVC) Water Pipe: Pipe size shall be 6" through 12" only, AWWA C905, rated DR 18 (Class 150), continually marked as required. Pipe sizes 16" through 24" may be used for transmission lines; no house service taps/laterals are allowed in these sizes. Pipe shall be DR-18 only, conforming to the requirements of AWWA C905
 - a. Elastomeric gaskets and lubricant: ASTM D1869 and F477 for smaller pipes.
 - b. Pipe joints: Integrally molded bell ends, ASTM D3139.

2.2 VALVES

- A. Gate Valves, 3-Inches and Larger:
 1. Manufacturer and Model: Mueller Resilient Wedge Gate Valves or approved equal.
 2. AWWA C509, iron body, non-rising stem with square nut, single wedge, resilient seat, flanged or mechanical joint ends, control rod, post indicator where indicated on Construction Drawings, extension box and valve key.
- B. Ball Valves, 3-Inches and Smaller:
 1. Manufacturer and Model: Mueller Oriseal or approved equal.
 2. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.
- C. Butterfly Valves, From 2-Inch to 24-Inch: AWWA C504, Iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.
- D. Check Valves, Post Indicator Valves, And Backflow Preventers: Refer to Section 13900 - Fire Suppression.
- E. Mark manufacturer's name and pressure rating on valve body.

2.3 FIRE HYDRANTS

- A. Fire Hydrants: Type as required by utility company/Local Fire Department and as shown on Construction Drawings.
- B. Hydrant Extensions: Fabricate in multiples of 6-inches with rod and coupling to increase barrel length.
- C. Hose and Steamer Connections: Match sizes with utility company, with two hose nozzles, one pumper nozzle.
- D. Finish: Apply primer and 2 coats of enamel or special coating to color as required by utility company.

2.4 ACCESSORIES

- A. Thrust Blocking: Place 2500 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 pounds per square foot when water main pressure is 100 psi.

MINIMUM THRUST BLOCKING BEARING AREAS

Pipe Diameter	Tees Sq. Ft	90° Bend Sq. Ft	45° Bend Sq. Ft	22½° Bend Sq. Ft.	11¼° Bend Sq. Ft.	5 5/8 Bend Sq. Ft.	Cap/Plug Sq. Ft.
3"	1.0	1.0	1.0	1.0	1.0	1.0	1.5
4"	1.0	1.0	1.0	1.0	1.0	1.0	2.0
6"	1.5	2.0	1.0	1.0	1.0	1.0	3.0
8"	2.5	3.5	1.8	1.0	1.0	1.0	4.0
10"	4.0	5.5	2.8	1.5	1.0	1.0	6.0
12"	6.0	8.0	4.0	2.0	1.5	1.0	8.5
14"	8.0	11.0	5.5	3.0	2.0	1.5	12.0
16"	10.0	14.2	7.0	4.0	3.0	2.5	15.0
18"	21.0	21.0	12.0	6.0	4.0	3.5	24.0

- B. Locked mechanical joint fittings shall be installed where vertical changes in direction are required and, if approved by Owner and governing authority, can be installed in lieu of above thrust blocking requirements.
- C. Polyethylene Encasement: Single layer of two ply cross-laminated high density polyethylene encasement per AWWA C105, Section 4.1.2, Type III, Class C (Black), Grade 33, tensile strength 5,000 psi minimum, elongation 100 percent, thickness nominal 0.004 inch (4 mil).
- D. Trace Wire: Magnetic detectable conductor, (#12 Copper) brightly colored plastic covering imprinted with “Water Service” in large letters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and depth are as indicated on Construction Drawings.

3.2 PREPARATION

- A. Ream pipe and tube ends and remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare pipe for connections to equipment with flanges or unions.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.3 TRENCHING AND BEDDING

- A. Excavate pipe trench and place bedding material in accordance with Section 02300.

3.4 INSTALLATION – GENERAL

- A. Perform installation in accordance with utility company or municipality requirements which shall take precedence over requirements stated herein when difference exists.

3.5 INSTALLATION - PIPE AND FITTINGS

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local codes.
- B. Install ductile iron pipe and fittings in accordance with AWWA C600.
- C. Install PVC pipe and fittings in accordance with AWWA C605.
- D. Ductile iron pipe and fittings shall be installed with polyethylene encasement around the pipe for the entire length of the project except where water main is within steel casing or is concrete encased. Install polyethylene encasement in accordance with AWWA C105, Method A.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.
- F. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.
- G. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions with least interference with operation of existing pipeline and in compliance with local utility company.
- H. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.
- I. Place pipe to depth in accordance with Section 02300.
- J. Backfill trench in accordance with Section 02300.
- K. Install trace wire continuous over top of non-metal pipe. Bury a minimum of 6 inches below finish grade, and above pipeline.

3.6 INSTALLATION - VALVES AND HYDRANTS

- A. Install gate valves as indicated on Construction Drawings. Support valve on concrete pads with valve stem vertical and plumb. Install valve boxes in manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.
- B. Install fire hydrant assemblies as indicated on Construction Drawings in vertical and plumb position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to street, roadway, or parking lot drive or toward protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly brace on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6-cubic feet of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Maintain vertical position of hydrant backfilling and compacting.

3.7 FLUSHING OF PIPING

- A. Thoroughly flush underground piping from the water supply to the system riser, and lead-in connections to the system riser, before the connection is made to downstream fire protection system piping. Continue flushing for sufficient time to ensure through cleaning.
- B. The minimum rate of flow shall be not less than one of the following:
 1. 1,560 GPM for 8 in. piping; 2,440 GPM for 10 in. piping; and 3,520 GPM for 12 in. piping.
 2. Maximum flow rate available to the system under fire conditions.
 3. When supply cannot produce stipulated flow rates, obtain maximum available.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Perform disinfection of potable lines in accordance with AWWA C651.
- B. Disinfect distribution system with chlorine before acceptance for domestic operation. Chlorine dosage shall be not less than 50 parts per million. Flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours. Flush with clean water after contact period until residual chlorine content is not greater than 1.0 part per million. Flush water discharged from water supply lines or hydrants shall not be allowed to discharge directly onto exposed soil or turf which could result in erosion of soil. If potential for erosion exists at discharge point, measures shall be taken to prevent erosion. Open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriological test in accordance with AWWA C651. Do not place distribution system in service until approval is obtained from local governing authorities.
- C. Provide a means of neutralizing the super-chlorinated water before releasing into the environment. This may be accomplished by either a method of dechlorination, direct release into a detention area approved by Wal-Mart, or any method acceptable to federal, state, and local codes. Direct release to open ground shall not be allowed, unless contained within an onsite detention facility with 6" permanent storage. In this case, the Contractor shall time the release to assure that no rainstorms are imminent. The intent of this condition is to allow the majority of the chlorine to evaporate into the atmosphere before a rainstorm has the opportunity to wash the residual downstream. Contractor shall not release super-chlorinated water directly into the sanitary sewer system, private or public, nor any storm drain system not directly discharging into the detention facility.

3.9 SERVICE CONNECTIONS

- A. Provide water service connection in compliance with utility company requirements including reduced pressure backflow preventer (if required) and water meter with by-pass valves and sand strainer.

3.10 FIELD QUALITY CONTROL

- A. Test water distribution system pipe installed below grade and outside building in accordance with the following procedures:
 1. Perform testing of pipe materials, joints, and other materials incorporated into construction of water mains and force mains to determine leakage and water tightness. In the event state or local code requires more stringent test, more stringent test shall take precedence.
 2. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water. Hydrostatically test at 200 psi, or 50 psi in excess of the system working pressure, whichever is greater, and shall maintain that pressure at +/- 5 psi for 2 hours. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage shall be 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
 3. Provide the completed Contractor's Material And Test Certificate For Underground Piping included at the end of this Section.
- B. Prepare reports of testing activities.

END SECTION

CONTRACTOR'S MATERIAL AND TEST CERTIFICATE FOR UNDERGROUND PIPING

Store Number: City, ST:	Date:
Pipe Type and Class:	Type Joint :

Underground Pipes And Joints	Pipe conforms to NFPA 13/24: <input type="checkbox"/> Yes <input type="checkbox"/> No		
	Fittings conform to NFPA 13/ 24: <input type="checkbox"/> Yes <input type="checkbox"/> No		
	If no explain :		
	Joints anchored clamped, strapped, or blocked in accordance with NFPA 13/24: <input type="checkbox"/> Yes <input type="checkbox"/> No		
	If no, explain:		
Test Description	<p>Flushing: Flow the required rate until water is clear and indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at flows not less than 390 gpm for 4 in. pipe, 880 gpm for 6 in. pipe, 1560 gpm for 8 in. pipe, 2440 gpm for 10 in. pipe, and 3520 gpm for 12 in. pipe. When supply cannot produce stipulated flow rates, obtain maximum available.</p> <p>Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi or 50 psi in excess of the system working pressure, whichever is greater, and shall maintain that pressure ± 5 psi for 2 hours.</p> <p>Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the equation in the Leakage Test section.</p>		
Flushing Test	New underground piping and lead in flushed according to NFPA 13/24: <input type="checkbox"/> Yes <input type="checkbox"/> No		
	If no, explain :		
	How flushing flow was obtained:	Through what type opening:	
	Public water <input type="checkbox"/>	Hydrant butt <input type="checkbox"/>	
	Tank or Reservoir <input type="checkbox"/>	Open pipe <input type="checkbox"/>	
	Fire pump <input type="checkbox"/>		
Hydrostatic Test	All new underground piping hydrostatically tested at _____ psi for _____ hours. If no, explain:	Joints Covered: <input type="checkbox"/> Yes <input type="checkbox"/> No	
Leakage Test	$L = \frac{SD\sqrt{P}}{148,000}$	$L = \frac{(\text{_____ ft}) \times (\text{_____ in}) \times \sqrt{(\text{_____})}}{148,000} \text{ psi}$	
	L= testing allowance, gal per hr S= length of pipe, ft D= nominal diameter of pipe, in. P= Avg test pressure during hydrostatic test, psi	L= Allowable leakage: _____ gal _____ hrs Leakage measured: _____ gal _____ hrs Leakage actual < leakage allowed? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Hydrants	Number installed:	Manufacturer & Model:	All operate satisfactorily: <input type="checkbox"/> Yes <input type="checkbox"/> No
	Water control valves left wide open: If no, explain:		<input type="checkbox"/> Yes <input type="checkbox"/> No
	Hose threads of fire department connections and hydrants compatible with AHJ:		<input type="checkbox"/> Yes <input type="checkbox"/> No
Signatures	Contractor Firm & Contact Name:		
	Signature:	Title:	Date:
	AHJ Witness:	Representing:	
	Signature:	Title:	Date:

END OF FORM

SECTION 02535 (33 3000) - SANITARY SEWAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewer drainage piping, fittings, accessories, cleanouts, and bedding.
2. Connection of site sanitary sewer system to municipal sanitary sewer systems.

B. Related Requirements:

1. Section 02300 – Earthwork: Trenching, backfill, and compaction for utilities
2. Section 02536 - Sewer Manholes, Frames, and Covers
3. Section 03310 – Cast-in-place Structural Concrete

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. ASTM International (ASTM):

1. ASTM A74 - Cast Iron Soil Pipe and Fittings
2. ASTM A746 - Ductile Iron Gravity Sewer Pipe
3. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings
4. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings
5. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
6. ASTM D2241 - Poly (vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
7. ASTM D2657 - Heat-Joining Polyolefin pipe and Fittings
8. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
9. ASTM D3035 - Polyethylene (PE) Plastic Pipe Using Flexible Elastomeric Seals
10. ASTM D3139 - Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals
11. ASTM D3261 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings For Polyethylene Plastic Pipe And Tubing
12. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe
13. ASTM F1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

C. American Water Works Association (AWWA):

1. AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
2. AWWA C600 - Ductile-Iron Water Mains And Their Appurtenances
3. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In, For Water Distribution
4. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing And Fittings 1/2 Inch Through 3 Inches, For Water Distribution
5. AWWA C906 - Polyethylene (PE) Pressure Pipe And Fittings, 4 Inch Through 63 Inch, For Water Distribution

D. City of Stockton Standard Specifications

1.3 SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, cleanouts, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.4 PROJECT CONDITIONS

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- A. Coordinate work with termination of sanitary sewer connection outside building and connection to municipal sewer utility service.

PART 2 - PRODUCTS

2.1 SEWER PIPE, FITTINGS, AND JOINTS

- A. Polyvinyl Chloride Pipe (PVC): ASTM D 3034, rated SDR 26 unless otherwise specified by the utility company. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification.
 - 1. Pipe joints: Integrally molded bell ends, ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant.
- B. Vitrified Clay Pipe (VCP): ASTM C700: Use only if required by local jurisdiction.
 - 1. Fittings: ASTM C700
 - 2. Joints: ASTM C425
 - 3. Gaskets: ASTM C425. Gaskets shall be manufactured from high grade, properly vulcanized elastomeric compound consisting of either basic natural or synthetic rubber. Gasket manufacturing tolerances shall comply with Rubber Manufacturer's Association tolerances for gaskets.
 - 4. Lubricant: Suitable for lubricating joint components; no deteriorating effects on gasket or pipe material, will not support growth of fungi or bacteria, and shall be of type recommended by gasket manufacturer.

2.2 PIPE ACCESSORIES

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene-ribbed gasket for positive seal.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps, etc.

2.3 CLEANOUTS AND MANHOLES

- A. Manholes shall conform to Section 02536.
- B. Lid and Frame: Provide in accordance with Section 02536. Provide traffic grade and rated covers and frames where cleanouts and manholes are within pavement, with the letters "SSCO" or "SANITARY SEWER" respectively cast into the cover.
- C. Shaft Construction: Cast iron shaft of internal diameter as specified on Construction Drawings with 2500 psi concrete collar for cleanouts.

2.4 APPURTENANCES

- A. Trace Wire: Magnetic detectable conductor (#12 copper), brightly colored plastic covering, imprinted with "Sanitary Sewer Service" in large letters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Construction Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with bedding material.

- B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate trench and place bedding material in accordance with Section 02300.

3.4 INSTALLATION - PIPE

- A. Install type and class of pipe as shown on the drawings. Pipes shall be laid and maintained to the required line and grade with necessary fittings, bends, manhole risers, cleanouts and other appurtenances placed at the required locations. The pipe shall be installed with uniform bearing under the full length of the barrel of the pipe. The pipe shall be inspected for defects and cracks before being lowered into the trench. Defective, damaged or unsound pipe, or pipe that has had its grade disturbed after laying shall be taken up and replaced. Commence installation at lowest point with the bell end upgrade.
- B. No pipe shall be laid in water or when trench conditions are unsuitable for work.
- C. Pipe connecting to manholes or other structures shall terminate flush inside of the structure wall.
- D. Joints for PVC and CISP shall be thoroughly lubricated with an approved lubricant before pipe sections are slipped together. Open ends shall be fully protected with a stopper to prevent earth or other material from entering the pipe during construction. Carefully free interior of the pipe from dirt, cement and other deleterious material as the work progresses.
- E. Maintain separation of potable water main from sewer piping at crossings a minimum of 10 feet horizontal and 18 inches vertical.
- F. Install HDPE piping and fittings to AWWA C901 and C906. Butt fusion welded per ASTM D3261.
- G. Route pipe in straight line parallel to roads, buildings and adjacent utilities and as shown on the drawings.
- H. Establish elevations of buried piping with sufficient cover as recommended by pipe manufacturer to ensure not less than 3 feet of cover, except as noted on drawings.
- I. Form and place concrete for thrust blocks at each elbow of pipe force main. See construction drawing for details of construction.
- J. Backfill trench in accordance with Section 02300.
- K. Install trace wire continuous over top of non-metal pipe. Bury 6 inches minimum below finish grade, above pipe-line.

3.5 INSTALLATION – CLEANOUTS AND MANHOLES

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. For cleanouts, form and place cast-in-place concrete base pad with provision for sanitary sewer pipe to be installed to proper elevations.
- C. For manholes, construct inverts according to the following guidelines:
 - 1. Invert channel shall be smooth and accurately shaped to a semicircular bottom to match with the inside of the adjacent sewer section.
 - 2. Invert channels and structure bottoms shall be shaped with mortar and lean concrete.
 - 3. Changes in size and grade of invert shall be made gradually and evenly.
 - 4. Changes in the direction of the sewer entering branch or branches shall have a true curve of as large a radius as the manhole will permit.

- D. For manholes, provide manhole rings, frame, and cover as shown on the construction drawings.

3.6 FIELD QUALITY CONTROL

- A. Field quality control shall be conducted by the Contractor in accordance with Section 01452.
- B. Pipes and joints shall not be completely backfilled until after inspection, testing, and approval by the Owner and local jurisdiction.
- C. Prior to testing for leakage, the pipe trench shall be backfilled to at least the spring line of the pipe. If required to prevent pipe movement during testing, additional backfill shall be added leaving the pipe joints uncovered to permit inspection.
- D. Air Pressure Exfiltration Test: Gravity systems shall be air tested between manholes at 3.5 psi for 5 minutes per ASTM F1417 for plastic pipes.
 - 1. Each section of sewer line between successive manholes shall be tested by plugging the upper and lower ends of the line using pneumatic plugs.
 - 2. The sewer line shall be filled to an air pressure of 4 psi and held for two minutes to allow for stabilization of the air pressure meter. After meter stabilization, the pressure shall be reduced to 3.5 psi and held for 5 minutes per ASTM F-1417 for plastic pipe.
 - 3. The allowable net pressure drop will be 0.5 psi
 - 4. An example Air Pressure Exfiltration Test Report is included in Appendix A. This form contains the minimum air pressure exfiltration testing and reporting standards to meet owner requirements. Contractor shall ensure minimum requirements of applicable AHJs are also performed and recorded.
 - 5. Report shall include photographs taken by the contractor during testing.
- E. Deflection Test:
 - 1. Deflection tests shall be conducted on all plastic pipe using a mandrel with a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.
 - 2. Allowable Deflection: Maximum allowable pipe deflection shall not exceed 5 percent of nominal inside diameter.
 - 3. Mandrel: Mandrel, go/no-go, device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with fewer arms will be rejected as not sufficiently accurate. Contact length of mandrel's arms shall equal or exceed nominal inside diameter of sewer to be inspected. Critical mandrel dimensions shall carry tolerance of 0.01-inch maximum. Contractor shall provide mandrel and necessary equipment for mandrel test.
 - 4. Procedure: Mandrel shall be hand-pulled through flexible pipe sewer lines no earlier than 30 days after trench has been completely backfilled. Sections of sewer not passing mandrel shall be uncovered and rebedded, rerounded, or replaced to satisfaction of Owner or governing agency. Repaired section shall be retested.
 - 5. An example Deflection Test Report is included in Appendix A. This form contains the minimum deflection testing and reporting standards to meet owner requirements. Contractor shall ensure minimum requirements of applicable AHJs are also performed and recorded.
 - 6. Report shall include photographs taken by the contractor during testing.
- F. Hydrostatic Test: Force main piping shall be hydrostatically tested at 150 psi in accordance with AWWA C 600.
- G. Provide measuring devices, meters, water, materials, and labor for making the required tests.
- H. Tests shall be conducted in the presence of the Construction Manager or his designee. Test data shall be submitted to the Engineer for review and approval.
- I. All testing shall be completed prior to placing any line in service. The contractor shall be responsible for the safety of all participants and shall follow all OSHA mandated guidelines, including those for Confined Space Entries.

- J. The Design Engineer is required to provide certification that the sewer system has been installed as per the plans and specifications prior to final acceptance. The contractor must adhere to the following requirements in order for the Engineer to provide the required certification:
1. Submit a construction schedule to the Engineer a minimum of 14 days prior to beginning the sewer line construction.
 2. Do not begin public sewer line construction without the Engineer's representative on site.
 3. Do not cover any section of the sewer line that has not been inspected by the Engineer's representative.
 4. Provide all backfill density test results, as taken by the owner's on site testing laboratory and by the general contractor, to the Engineer.
 5. Perform required final exfiltration and deflection tests for gravity lines and pressure and leakage tests for force main in accordance with the Contract Documents. It shall be the Contractor's responsibility to ensure that all tests have been successfully performed prior to requesting the presence of the Engineer's representative for observation of the final tests.
 6. Provide written results, of all required tests, to the Engineer.
 7. Provide an as-built survey of the sewer system improvements, certified by a licensed surveyor, and which shows both horizontal and vertical alignment, to the Engineer.

END OF SECTION

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TESTING REPORT
SANITARY SEWER PIPE
AIR PRESSURE EXFILTRATION TEST

PROJECT NAME: _____

PROJECT NUMBER: _____

INSPECTOR:

DATE OF TESTING:

MANHOLE # _____ to MANHOLE # _____

TYPE OF PLUGS USED: _____

PIPE SIZE: _____

PIPE MATERIAL: _____

DISTANCE BETWEEN MANHOLES: _____

TESTING TIME (MIN): _____ BEGINNING PRESSURE (PSI): _____

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ENDING PRESSURE (PSI): _____ AT _____
_____ MIN

NET PRESSURE DROP: _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

TYPE OF PLUGS USED: _____

PIPE SIZE: _____

PIPE MATERIAL: _____

DISTANCE BETWEEN MANHOLES: _____

TESTING TIME (MIN): _____ BEGINNING PRESSURE (PSI): _____

ENDING PRESSURE (PSI): _____ AT _____
_____ MIN

NET PRESSURE DROP: _____

PASS or FAIL (circle one)

COMMENTS:

SIGNATURE: _____

DATE: _____

TESTING REPORT SHEET _____ OF _____

TESTING REPORT
SANITARY SEWER PIPE
DEFLECTION TEST

PROJECT NAME: _____

PROJECT NUMBER: _____

INSPECTOR:

DATE OF TESTING:

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

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PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

MANHOLE # _____ to MANHOLE # _____

PASS or FAIL (circle one)

COMMENTS:

SIGNATURE: _____

DATE: _____

TESTING REPORT SHEET _____ OF _____

SECTION 02536 (33 3913) - SEWER MANHOLES, FRAMES, AND COVERS

PART 1 - GENERAL

1.1 SUMMARY

1.2 Section Includes:

1. Monolithic concrete, modular precast concrete, masonry, and precast polyethylene manhole assemblies.

1.3 Related Requirements:

1. Section 01351 – Regulatory Compliance:
 - a. Disposal and removal of construction and universal waste.
 - b. Work practice control methods for airborne respirable dust.
2. Section 02300 - Earthwork. Excavation, backfill, and compaction.
3. Section 02535- Sanitary Sewer Systems.
4. Section 02630 - Storm Drainage.

1.4 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 1. ASTM A48 - Gray Iron Castings.
 2. ASTM C55 - Concrete Building Brick.
 3. ASTM C94 - Ready Mixed Concrete.
 4. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
 5. ASTM C990 - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 6. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
 7. ASTM D2412 - Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- C. International Masonry Industry All-Weather Council (IMIAC):
 1. Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
- D. Occupational Safety and Health Administration (OSHA):
 1. OSHA 01926.1153 Respirable Crystalline Silica.
- E. State of California Department of Transportation (CALTRANS):
 1. 2018 Standard Specifications
- F. City of Stockton Standard Specifications

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Minimize dust emissions and provide equipment that suppresses dust when cutting concrete or masonry.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate reference to Construction Drawings of manhole locations, elevations, piping with sizes, locations, and elevations of penetrations.

B.

PART 2 - PRODUCTS

2.1 MANHOLES

- A. Precast Concrete: Reinforced precast concrete barrel.
1. Manhole Sections: ASTM C478.
 2. Joints and Joint Sealant: Joint between manhole barrel sections shall conform to ASTM C990 using preformed flexible joint sealant.
 3. Pipe Connection Sealant: Joint material between manhole barrel and adjoining pipe shall be as shown on the drawings.
 4. Construct manholes of precast concrete sections as required by Construction Drawings to size, shape, and depth indicated.
 5. All sanitary manholes are to be tested for water tightness in accordance with ASTM C969 "Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines", or ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by the Negative Pressure (Vacuum) Test".
- B. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than 2-inches deep shall be repaired using Class "D" mortar.
- C. Brick Transition Reinforcement: Formed steel 8-gauge wire with galvanized finish.
- D. Configuration:
1. Barrel Construction: Concentric with eccentric cone top section.
 2. Shape: Cylindrical.
 3. Clear Inside Dimensions: 48-inches diameter minimum or as indicated on Construction Drawings.
 4. Design Depth: As indicated on Construction Drawings.
 5. Clear Lid Opening: 22-inches minimum.
 6. Pipe Entry: Provide openings as indicated on Construction Drawings.
 7. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls. Point up irregularities and rough edges with nonshrinking grout.
- E. Inverts: Shape inverts for smooth flow across structure floor as indicated on Construction Drawings. Use concrete and mortar to obtain proper grade and contour. Finish surface with fine textured wood float.

2.2 COMPONENTS

- A. Lid and Frame:
1. Manufacturer: One of the following or approved equal:
 - a. Bass & Hays Foundry.
 - b. Deeter Foundry, Inc.
 - c. East Jordan Iron Works.
 - d. Neenah Foundry.
 - e. U.S. Foundry & Manufacturing
 2. ASTM A48, Class 30B minimum, heavy duty cast iron construction, machined flat bearing surface.
 3. Removable lid, closed or open as indicated on Construction Drawings, with sealing gasket.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify items specified by other Sections are properly sized and located.

- B. Verify that built-in items are in proper location and ready for roughing into work.
- C. Verify that the excavation for manholes is correct.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on Construction Drawings.

3.3 PRECAST MANHOLE CONSTRUCTION

- A. Place base pad to proper elevation and location and trowel top surface level for placement of manhole barrel.
- B. Place manhole barrel plumb and level to correct elevations and anchor to base pad.
 1. After completion of slab foundation, lower first joint of manhole barrel into position, grooved end first, and set level and plumb on concrete base. Align and adjust to proper grade prior to placing and forming invert. Pour invert immediately after setting of first section of manhole barrel.
 2. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer's recommendations. Place joint sealant on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.
- C. Set cover frames and lids level without tipping, to correct elevations. Utilize pre-cast rings or brick and mortar to achieve final rim elevation. Maximum limit, 4 courses.

3.4 FIELD QUALITY CONTROL

- A. Vacuum Test: All sanitary sewer manholes shall be vacuum tested in accordance with ASTM C1244-11, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
 1. Plug all manhole entrances and exits other than the manhole top access using suitably sized pneumatic or mechanical pipeline plugs and follow all manufacturer's recommendations and warnings for proper and safe installation of such plugs. Plugs should be inserted a minimum of 6" beyond manhole wall.
 2. Install the vacuum tester head assembly at the top access of manhole. (If using a "plate" style manhole tester, position the plate on the manhole ring assembly.)
 3. Attach the vacuum pump assembly to the proper connection on the test head assembly. Make sure the vacuum inlet/outlet valve is in the closed position.
 4. Following safety precautions and manufacturer's instructions, inflate sealing element to the recommended maximum inflation pressure.
 5. Start the vacuum pump and allow pre-set RPM to stabilize.
 6. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg. (approximately negative 5 psig, 0.3 bar).
 7. Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.
 8. Manholes in asphalted areas cannot be tested until subbase for asphalt has been stabilized.
 9. An example Vacuum Test Report is included in Appendix A. This form contains the minimum vacuum testing and reporting standards to meet owner requirements. Contractor shall ensure minimum requirements of applicable AHJs are also performed and recorded.
 10. Report shall include photographs taken by the contractor during testing.

11.

Depth (ft.)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
	Times (s)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	65	74	87	98	108	121

END OF SECTION

SECTION 02630 (33 4000) - STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm sewer drainage piping, fittings, and accessories.
2. Storm drainage structures.

1.2 Related Requirements:

1. Section 02300 – Earthwork: Excavation, trenching, backfill, and compaction.
2. Section 02370 – Erosion and Sedimentation Control (Including SWPPP).
3. Section 02536 - Sewer Manholes, Frames, and Covers.
4. Section 03310 – Structural concrete and exterior Concrete Slabs: Materials for concrete: See Architectural / Building Specifications.
5. Section 03311 – Sitework Structural Concrete: Requirements and installation for concrete for storm drainage structures included in this Section.
6. Appendix B – Testing, Inspection, and Observation by Owner (includes 01456 CEC Site Observation Requirements).

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M 170 – Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
2. AASHTO M 190 - Bituminous Coated Corrugated Metal Culvert Pipe and Arches.
3. AASHTO M 252 - Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter.
4. AASHTO M 294 - Corrugated Polyethylene Drainage Tubing, 12 to 60 Inch Diameter.
5. AASHTO M 306 - Drainage, Sewer, Utility, and Related Casting
6. AASHTO M 330 - Polypropylene Pipe, 300- to 1500-mm (12- to 60-in) Diameter

C. ASTM International (ASTM):

1. ASTM A 74 - Cast Iron Soil Pipe and Fittings.
2. ASTM A 185 - Steel welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A 674 – Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
5. ASTM A 746 - Ductile Iron Gravity Sewer Pipe.
6. ASTM A 760 - Corrugated Steel Pipe, Metallic-Coated For Sewers And Drains.
7. ASTM A 796 - Structural Design Of Corrugated Steel Pipe, Pipe-Arches, And Arches For Storm And Sanitary Sewers And Other Buried Applications.
8. ASTM A 798 - Factory-Made Corrugated Steel Pipe For Sewers And Other Applications.
9. ASTM A 929 - Steel Sheet, Metallic-Coated By The Hot-Dip Process For Corrugated Steel Pipe.
10. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
11. ASTM C 150 - Portland Cement.
12. ASTM C 206 - Finished Hydrated Lime.
13. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
14. ASTM C 564 - Rubber Gasket for Cast Iron Soil Pipe and Fittings.
15. ASTM C 924 - Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
16. ASTM C 969 - Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
17. ASTM C 990 - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

18. ASTM C 1628 – Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets.
19. ASTM D 2321 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
20. ASTM D 3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
21. ASTM D 3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
22. ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
23. ASTM F 949 - Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
24. ASTM F 1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
25. ASTM F 2306 - 12 to 60 Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
26. ASTM F 2487 – Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines.
27. ASTM F 2736 - 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe.
28. ASTM F 2764 - 30 to 60 in. Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.
29. ASTM F 2881 - 12 to 60 in. Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

D. American Concrete Institute (ACI):

1. ACI 301 - Structural Concrete for Buildings.

E. UNI-Bell PVC Pipe Association:

1. UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

F. City of Stockton Standard Specifications

G. State of California Water Code, latest edition

1.4 SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations. Prepare and provide any required record drawings to the utility company or municipality.
2. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.5 PROJECT CONDITIONS

- A. Coordinate work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Pipe and joint materials specified below for storm drainage shall be strictly limited to the extent shown or allowed on the drawings or as specified in Part 3 hereinafter. Metal conduits including corrugated metal pipe will not be acceptable in closed conduit system.
- B. Reinforced Concrete Pipe (RCP): ASTM C 76, Class III unless noted otherwise on Drawings.
1. Joint Material: Provide joints to the extent allowable in Part 3 Joints.
 - a. Rubber O-ring Gasket: ASTM C 443, ASTM C 1628.
 - b. Bitumen or Butyl-Rubber Sealant: ASTM C990.
 2. Flared End Sections: ASTM C 76 or, for sections with toe wall, AASHTO M 170.
 3. Conforming to California Department of Transportation Standard Specifications, Section 65.
- C. Ductile Iron Pipe (DIP): ASTM A 746.

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1. Fittings: Cast iron, ASTM A 74.
 2. Joint Material: Rubber Gasket, ASTM C 564 for compression joints.
- D. Polypropylene Pipe (PP): AASHTO M 330, ASTM F 2881, F2736, and F2764. Use only where specifically indicated on Drawings.
1. Joint Material: As shown in table in Part 3 for the type of joint allowed.
 - a. Rubber Gasket: ASTM F477
 - b. Rubber Gasket Joints: ASTM 3212.
- E. High Density Polyethylene Pipe (HDPE): AASHTO M 252 Type S or SP, M 294 Type S or SP, or ASTM F 2306 smooth interior/annular exterior. Use only where specifically indicated on Drawings.
1. Joint Material: As shown in table in Part 3 for the type of joint allowed.
 - a. Rubber Gasket: ASTM F477
 - b. Rubber Gasket Joints: ASTM 3212.
 - c. Corrugated Coupling Bands: As recommended by manufacturer.
- F. Polyvinyl Chloride (PVC) Pipe: ASTM D 3034, rated SDR 35, or ASTM F 949 for Profile Pipe, continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D3034 classification. Only permitted when specifically indicated on Drawings.
1. Joint Material: As shown in table in Part 3 for the type of joint allowed.
 - a. Rubber Gasket: ASTM F477
 - b. Rubber Gasket Joints: ASTM 3212.
- G. Corrugated Steel (Metal) Pipe (CSP or CMP): ASTM A 760, pipe gauge shall be as shown on the drawings. Galvanized, aluminized (Type 1R), or bituminous coated as specified on Drawings. Use only where specifically indicated on Drawings. Corrugated steel pipe may be round pipe, arch pipe, or slotted drainpipe as indicated on Drawings. Slotted drainpipe shall have 1.75-inches wide drain waterway openings and 6 inches minimum height drain guide.
1. CSP, bands and appurtenances shall be uniformly coated inside and outside with a 0.05 inch minimum thickness bituminous coating in accordance with AASHTO M 190.
 2. CSP shall be supplied with paved inverts or fully lined to provide a smooth interior, smooth flow lining only as indicated on the drawings.
 3. Joint Material:
 - a. Semi-corrugated "Hugger" type bands and "O" ring gaskets.
 - b. Semi-corrugated "Hugger" type bands.
- H. Spiral Rib Metal Pipe: ASTM A760 Type 1R or Type IIR. Coatings shall meet requirements of ASTM A 929 and shall be galvanized, aluminized, or bituminous coated as specified on Drawings. Use only where specifically indicated on Drawings.
1. Pipe gauge shall be as shown on the construction drawings. Standard corrugated steel pipe (CMP or CSP) shall not be substituted for Spiral Rib Metal Pipe.
 2. Acceptable manufacturers: Provide the following or approved equal:
 - a. Ultra Flo or Ultra Flo II by Contech, Inc.
 - b. Max Flow by Southeast Culvert, Inc.
 - c. Max Flow by St. Regis Culvert, Inc.
 - d. Max Flow by Thompson Culvert, Inc.
 3. Joint Material: Provide joints to the extent allowable in Part 3 Joints.
 - a. Semi-corrugated "Hugger" type bands and "O" ring gaskets.
 4. Semi-corrugated "Hugger" type bands.
- I. Subdrains: Perforated, PVC or flexible corrugated HDPE pipe as specified herein of the size indicated on the drawings.

2.2 ACCESSORIES

- A. Encasement for Piping: ASTM A 674. Where required for corrosion protection for underground iron pipe and fittings.

1. Material: High-density, crosslaminated polyethylene (PE) film of 0.004-inch (0.10-mm) minimum thickness.
2. Form: Sheet or tube.
3. Color: Black.

2.3 DRAINAGE STRUCTURES

- A. Manholes: Conform to Section 02536.
- B. Grates and Frames: Provide in accordance with details shown on Drawings or equivalent by one of the following acceptable manufacturers. Project needs vary depending on geographic region. To be connected with the best suited supplier, contact the manufacturer whose territory is nearest Project location.
 1. Acceptable Manufacturers:
 - a. South, Southeast, East Central: [US Foundry](#) (An Eagle Manufacturing Co.). Contact Roy Kohlier, (800) 432-9709 or (786) 402-3435. rkohlier@usfoundry.com
 - b. Central, West Central, and East of Mississippi River: EJ Infrastructure Access Solutions d/b/a. [East Jordan Iron Works](#). Contact Joe Lazzati, Director of Sales, (410)-833-6100; mobile (443) 324-4589. joe.lazzati@ejco.com.
 - c. West, Northwest, Southwest, West Central: [D&L Foundry and Supply](#) (801) 785-5015.
 - d. Central, North Central: [Deeter Foundry](#). (800) 234-7466. sales@deeter.com
 - e. Northeast: [Neenah Foundry](#). (800) 558-5075.
 2. Standard Grates and Frames: Heavy duty grates, AASHTO M 306 load rating of H-20, with maximum slot width of 1-1/8" and minimum width of 1". Where project and regional conditions allow, provide one of the following:
 - a. Model 4230V-3 Grate and Frame by East Jordan (WM custom design).
Model 2512-1002 Grate (2 required) and 2512-0010 Frame by Deeter (WM custom design).
 3. Siphonic Break Manhole Grate and Frame: Heavy duty grate, AASHTO M 306 load rating of H-20, with maximum slot width of 1/2" and minimum net open area of 1.5 square feet. Where project and regional conditions allow, provide the following:
 - a. Model R-2750 Grate and Frame by Neenah (WM custom design).
- C. Concrete: Cast-In-Place concrete for drainage structures including manholes, inlets, catch basins, collars, support blocks, headwalls and paved ditches shall conform to the concrete requirements specified in Section 03311.
- D. Cement Mortar used for paving inverts, filling lift holes, joints, patching and anchoring castings shall consist of one part Portland cement, type I, ASTM C 150, 1/4 part hydrated lime, ASTM C 206 and 2-1/2 parts clean, well-graded sand and water free of suspended matter, alkali, and containing no industrial or domestic waste.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with bedding material.
- B. Remove large stones or other hard matter that could damage piping or impede consistent backfilling or compaction.
- C. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.3 INSTALLATION – PIPE

- A. Install type of pipe shown on the drawings. Where type of pipe material is not shown or restricted on the drawings, provide only RCP or DIP. Installation provisions herein shall apply to the extent as applicable to the pipe and joints allowed.
- B. Inspect pipe for defects and cracks before being lowered into the trench, piece by piece. Remove and replace defective, damaged or unsound pipe or pipe that has had its grade disturbed after laying. Protect open ends with a stopper to prevent earth or other material from entering the pipe during construction. Remove dirt, excess water, and other foreign materials from the interior of the pipe during the pipe laying progress.
- C. Excavate pipe trench and place bedding material in accordance with Section 02300.
- D. Install pipe in accordance with manufacturer's written recommendations.
- E. Thermoplastic Pipe: Install pipe in accordance with pipe manufacturer's installation instructions and ASTM D 2321 and as indicated on the drawings.
- F. Corrugated or Spiral Rib Metal Pipe: Install as indicated on the drawings, as recommended by the manufacturer, and in accordance with ASTM A 798 and A 796 as they apply.
- G. HDPE Pipe: Install pipe in accordance with pipe manufacturer's installation Guidelines for Culvert Storm Drainage Applications and as indicated on the drawings.
- H. Install polyethylene corrosion-protection encasement around iron piping as indicated on the drawings, as recommended by the manufacturer, and in accordance with ASTM A 674.
- I. Commence installation at the lowest point for each segment of the route. Lay RCP with the groove or bell end upstream. Place riveted CSP with the inside circumferential laps pointing downstream. Repair damaged bituminous coating on CSP by applying bituminous material conforming to AASHTO M190.
- J. Lay pipe to the required line and slope gradients with the necessary fittings, bends, manhole, risers and other appurtenances placed at the required location as noted on Drawings.
- K. Do not displace or damage pipe when compacting.
- L. Do not place pipe in water or when trench conditions are unsuitable for such work.
- M. Joints: Construct joints as described herein and in accordance with manufacturer's installation instructions. Provide pipe joint type for soiltight, silttight, or watertight silttight or watertight only watertight joint performance in accordance with the following table. Rubber gasketed joints shall conform to ASTM D 3212. The table applies only to the extent as applicable to the pipe and joint type and the joint performance as shown or specified.

Pipe and Joint Type	Joint Performance		
	Watertight	Silttight	Soiltight
RCP			
Rubber O-Ring Gasket	x	x	x
Bitumen or Butyl Rubber Sealant			x
DIP			
Rubber Gasket	x	x	x
PP			
Rubber Gasket	x	x	x
HDPE			
Rubber Gasket	x	x	x
Corrugated Coupling Bands			x

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PVC			
Rubber Gasket	X	X	X
CMP or Spiral Rib Aluminum Pipe			
Hugger Band w/ O Ring Rubber Gasket		X	X
Hugger Band			X

3.4 INSTALLATION – MANHOLES, CATCH BASINS, INLETS, AND JUNCTION BOXES

- A. Construct drainage structures in accordance with details shown on Drawings and in accordance with Section 02536 as applicable.
- B. Precast Sections:
 - 1. Install precast section with bases in accordance with Section 02300 and 02536 or as shown on drawings.
 - 2. Align pipe openings to that of the pipe entering and leaving the manhole, etc. Properly Pipe with connections to manholes, etc. as shown on the drawings.
- C. Construction for Cast-In-Place sections as shown on the drawings and in accordance with the form requirements of Section 03311.
- D. Invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the inside of the adjacent sewer section. Shape invert channels and structure bottoms with cement mortar. Changes in size and grade of invert shall be made gradually and evenly. Changes in direction of the sewer entering branch or branches shall have a true curve of as large a radius as the manhole will permit.
- E. Frames and Covers:
 - 1. Set frames and covers to the proper elevation. Firmly embed frames in mortar approximately 1 inch thick and align to fit the top section of the structure.
 - 2. Limit bricks set in mortar and used to adjust the frame to finished grade to no more than four courses.
 - 3. Adjustment rings used to make adjustments in grade shall be made with the initial ring embedded in mortar and the exterior of the rings parge with mortar not less than 1/2 inch thick. No adjustment made in this manner shall exceed 8 inches.
- F. Construct concrete cradles as shown on the drawings and in accordance with the strength requirements of Section 03311 as needed when crossing over and under sewer pipe or utility lines.

3.5 SUBDRAINS

- A. Install subdrains in accordance with the details and at the locations shown on the drawings.

3.6 INSPECTION AND TESTING

- A. General:
 - 1. Clean, inspect, and test storm sewer systems and culverts, upon completion or at such time as directed. The system or culvert shall have a true grade and line. Actual elevations shall be within 0.08 feet of the elevations given on the drawings.
 - 2. After completion of the Work, or any part thereof, the job shall be tested to determine that it has been installed in accordance with the drawings and specifications. In general, the Work shall prove to be in good condition, installed in accordance with the drawings and specifications and ready for use.
- B. Cleaning and Testing:
 - 1. Visibly inspect and remove all debris and obstructions from storm pipe.
 - 2. Test for infiltration and exfiltration by hydrostatic testing per ASTM C 969. Manholes and concrete pipe shall conform to ASTM C 969 leakage criteria.

3. Test watertight joints in accordance with the requirements of jurisdictional authorities, UNI-B-6 and the following:
 - a. Option: Test plastic piping according to ASTM F 1417 or ASTM F 2487.
 - b. Option: Test concrete piping according to ASTM C 924 or ASTM C 969.
- C. Alignment Test: After backfill has been placed and compacted to a depth not less than one foot above top of pipe, a visual inspection shall be made by flashing a light between manholes. Correct displacement or misalignment of invert.

3.7 CIVIL ENGINEERING CONSULTANT (CEC) OBSERVATION

- A. Civil Engineering Consultant Observation: The Owner's Civil Engineering Consultant (CEC) will perform special observations as specified in Appendix B (Section 01456).

END OF SECTION

SECTION 02555 (33 5000) - NATURAL AND PROPANE GAS DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Pipe and fittings for site utility natural or propane gas distribution.
 2. Propane storage tanks and appurtenances.
 3. Connection of site natural gas system and private utility company system.
- B. Related Requirements:
1. Section 02300 – Earthwork: Trenching, backfill, and compaction for utilities

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
1. ASME B16.3 - Malleable Iron Threaded Fittings
 2. ASME B16.11 -Forged Steel Fittings, Socket Welding and Threaded
 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 5. ASME B31.8 - Gas Transmission and Distribution Piping Systems
 6. ASME S00081 – Boiler and Pressure Vessel Code, Sec VIII: Pressure Vessels
 7. ASME Q00090 - Boiler and Pressure Vessel Code, Sec. IX: Welding and Brazing Qualifications
 8. ASME Boiler and Pressure Code
- C. ASTM International (ASTM):
1. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated (Galvanized) Welded and Seamless
 2. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperature
 3. ASTM B32 - Solder Metal
 4. ASTM B88 - Seamless Copper Water Tube
 5. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
 6. ASTM D2517 - Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
 7. ASTM D2683 - Socket-Type Polyethylene Fittings For Outside Diameter-Controlled Polyethylene Pipe and Tubing
 8. ASTM D 3261 - Butt Heat Fusion Polyethylene (PE) Plastic Polyethylene (PE) Plastic Pipe And Tubing
- D. American Welding Society (AWS):
1. AWS A5.8 - Brazing Filler Metal
- E. American Water Works Association (AWWA):
1. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
- F. American National Standards Institute (ANSI):
1. ANSI B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
 2. ANSI B31.2 - Fuel Gas Piping
- G. National Fire Protection Agency (NFPA):
1. NFPA 54 - National Fuel Gas Code

1.3 QUALITY ASSURANCE

02555-1

- A. Welding Materials and Procedures: Conform to ASME Boiler and Pressure Vessel Code and applicable state regulations.
- B. Welders Certification: In accordance with ASME Q00090, Sec IX.
- C. Conform to NFPA 54, ANSI B31.2, or ASME B31.8.

1.4 SUBMITTALS

- A. Project Record Documents:
 1. Accurately record actual locations of pipe mains, valves, connections, and top of pipe elevations.
 2. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to be included.
- B. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 PIPE

- A. Steel Pipe:
 1. Below Ground: ASTM A53, Schedule 40, type E or S, grade B, black:
 - a. Fittings: ASME B16.11, forged steel, or ASTM A234 forged steel welding type.
 - b. Joints: Welded and seamless.
 - c. Jackets: AWWA C105 polyethylene jacket, double layer, half lapped, 10-mil polyethylene tape.
 2. Above Ground: ASTM A53, Schedule 40, type E or S, grade B, black:
 - a. Fittings: ASME B16.3, malleable iron, ASME B16.11, forged steel, or ASTM A234, forged steel welding type.
 - b. Joints: Threaded.
- B. Copper Tubing (Propane Piping):
 1. Below ground: ASTM B88, Type K, internally tinned:
 - a. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper; internally tinned.
 - b. Joint: AWS A5.8 BCuP silver brazed.
 2. Above ground: ASTM B88, Type K, L or ASTM B75, Type GP; internally tinned:
 - a. Fittings: ASME B16.18 cast copper, ASME B 16.22, wrought copper, or ANSI B16.26, cast copper, internally tinned.
 - b. Joint: ASTM B32, Solder, Grade 95TA or AWS A5.8, Bcup silver brazed.
- C. Polyethylene Pipe (below ground only): ASTM D-2513, SDR 11.5.
 1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.
 2. Joints: Mechanical or Compression fit.
- D. Reinforced Epoxy Resin Piping: ASTM D2517.
 1. Fittings: ASTM D2517.
 2. Joints: Bell and spigot with epoxy resin.

2.2 GAS COCKS

- A. 2 Inches and Smaller: 150 psig WOG, bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends with cast iron curb box, cover, and key.

- B. Larger than 2 inches: 125 psig WOG, Steel or Cast iron body and tapered plug, non-lubricated, Teflon packing, threaded ends, with cast iron curb box, cover, and key.
- C. For Applications with Line Pressure Greater than 60 psig: Over 2 Inches: Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends, with cast iron curb box, cover, and key.

2.3 Mark manufacturer's name and pressure rating on valve body

2.4 PRESSURE REGULATING VALVES

- A. Single stage, malleable iron body, corrosion-resistant, pressure regulator with atmospheric vent, elevation compensator; with threaded ends for 2 inches and smaller or flanged ends for larger than 2 inches. Install earthquake actuated automatic shutoff valve, if required by local code or utility.
- B. Capacity: For inlet and outlet gas pressures, specific gravity, and flow rate indicated.

2.5 PROPANE STORAGE TANKS

- A. Construction: Closed, welded steel, tested and stamped in accordance with ASME S00081, Sec VIII; minimum 250 psig rating; cleaned, prime coated, and painted with 2 coats of silver anti-rust paint, and supplied with steel support saddles, pressure gage, tapping for installation of piping and accessories.
- B. Vaporizer: 1,000 watts, heating cable bedded in 1-inch of glass fiber insulation and covered by flexible stainless steel plate, with thermostat in weatherproof box set to turn on at -13 degrees Fahrenheit with manual off-on switch.
- C. Capacity: Diameter and length as shown on Construction Drawings.

2.6 TRACE WIRE

- A. Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Natural Gas Service" in large letters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions.
- B. Verify that building service connection and utility gas main size, location, and depth are as indicated on Construction Drawings.

3.2 PREPARATION

- A. Ream pipe ends and remove burrs. Bevel plain end ferrous pipe over 2-inches diameter or thread ferrous pipe 2-inches diameter and under.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections with flanges or threading and unions.
- D. Comply with NFPA 54 on installation of gas lines.

3.3 BEDDING

- A. Excavate pipe trench and place bedding material in accordance with Section 02300.

3.4 INSTALLATION – GENERAL

- A. Perform installation in accordance with local utility company requirements in conjunction with requirements herein. Utility requirements shall take precedence when differences occur.

3.5 INSTALLATION - PIPING

- A. Maintain a minimum of 12 inches separation of gas line from sewer, water, or storm water piping in accordance with state or local code.
- B. Install piping to conserve space and not interfere with use of site space.
- C. Install piping to allow for expansion and contraction without stressing pipe or joints.
- D. Install cocks and other fittings as required.
- E. Establish elevations of buried piping in accordance with Section 02300.
- F. Wrap couplings and fittings of steel pipe with polyethylene tape and heat shrink over pipe in accordance with AWWA C105.
- G. Install trace wire continuous over top of pipe for nonmetallic pipe.
- H. Backfill trench in accordance with Section 02300.
- I. Center and plumb valve box over valve. Set box cover flush with finished ground surface. Prevent shock or stress from being transmitted through valve box to valve.
- J. Wrap valve and valve box with polyethylene tape and heat shrink or paint valves and valve boxes with red anti-rust primer and 1 coat of epoxy paint.

3.6 SERVICE CONNECTIONS

- A. Provide sleeve in foundation wall for gas service main. Caulk enlarged sleeve watertight.
- B. Anchor service main to interior surface of foundation wall.
- C. Install service regulator adjacent to building wall in specified location.
- D. Install service regulator and riser pipe to prevent undue stress on service pipe. For plastic service pipe, use steel pipe riser from below ground to regulator.
- E. Provide regulator vent with rain and insect proof opening, terminating not less than 5 feet away from building openings.

3.7 PROPANE TANK INSTALLATION

- A. Place tank legs on concrete pad, level within tolerance of 2 inches maximum.
- B. Prepare and grade an area outside the tank perimeter, for distance of 6 feet. Grade, place, and compact gravel fill to compacted depth of 3 inches minimum. Compact in accordance with Section 02300.
- C. Provide tank with relief valve, shutoff valve, pressure regulator, pressure gauge, and removable protection cover. Install piping, shutoff valve, and pressure gauge to underground piping.
- D. Set tank regulator to outlet pressure as indicated on Construction Drawings.

- E. Install vaporizer to underside of tank and secure to tank with aluminum tray and two stainless steel straps.
- F. Install weatherproof control box for vaporizer 40-inches above ground surface. Install on 4-inch x 4-inch cedar post, driven into ground 40 inches.
- G. Install control wire from vaporizer to control box 20 inches below ground surface. Install service wiring 24 inches below ground from control box to building.

END OF SECTION

REVISION NOTES:

Rev 1: (05/25/07) Added Field QC inspection by CTL in Part 3. (CI 7601)

Rev 2: (09/28/07) Changed field QC inspection from CTL to CEC. (CI 7785)

Rev 3: (02/15/11) Updated sign descriptions to coordinate with MUTCD and drawings. Added retroreflective sheeting provision. Added “All-Way” and 36 x 36 Stop Sign. Added square tubular and round steel pipe sign posts and deleted U-Channel posts. Added field painting reference. (WM/Richards)

Updated retroreflectivity type description in Part 2. (WM/Richards)SECTION 02890 (34 4113) - TRAFFIC SIGNS AND SIGNALS

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Traffic control signs.

B. Related Requirements:

1. Section 09900 - Painting. Painting for painted posts where shown on the Drawings.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. ASTM International (ASTM):

1. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. ASTM C94 - Ready Mix Concrete
3. ASTM D4956 - Retroreflective Sheeting for Traffic Control.

C. US Department of Transportation, Federal Highway Administration:

1. Manual on Uniform Traffic Control Devices (MUTCD).

PART 2 - PRODUCTS**2.1 SIGNS**

- A. Conform to US Department of Transportation [MUTCD](#). Sign classification, type, size, and color shall be as shown on the drawings

- B. Retroreflectivity: Microprismatic type, diamond grade reflective sheeting conforming to ASTM D 4956

2.2 POSTS

- A. Square Post: Square tubular steel sign post, galvanized, 12 ga, perforated full-length with 7/16 inch holes on four sides. Post size shall be as shown on the Drawings.

- B. Steel Pipe: ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 40, size as shown on the Drawings.

2.3 CONCRETE

- A. Mix concrete and deliver in accordance with ASTM C 94.

- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - 1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.
 - 2. Slump Range: 1 to 3-inches at time of placement
 - 3. Air Entrainment: 5 to 8 percent

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field verify underground utilities prior to sign installation. Primary utilities of concern of shallow depths are lawn sprinkler systems, electric, telephone, fiber optic, cable and gas.

3.2 INSTALLATION

- A. Install signs as shown on the Drawings and in accordance with MUTCD and manufacturer's instructions.
- B. Install signs of the type and at locations shown on the Drawings.
- C. Install posts of the type as shown on the drawing.
- D. Where shown as painted, field paint steel pipe posts in accordance with Section 09900.

END OF SECTION

APPENDIX B - CIVIL

TESTING, INSPECTION, AND OBSERVATION BY OWNER

Index of Sections (Quick Links): All sections listed may not be applicable to all projects.

1. [Section 01456 – Civil Engineering Consultant Site Observation](#)
2. [Section 02300 – Earthwork](#)
3. [Section 02340 – Soil Stabilization](#)
4. [Section 02621 – Foundation Drainage Piping](#)
5. [Section 02715 – Base Course](#)
6. [Section 02740 – Asphalt Concrete Paving](#)
7. [Section 02751 – Concrete Paving](#)
8. [Section 02900 – Planting](#)
9. [Section 03311 – Site Structural Concrete](#)

SECTION 01456 – CIVIL ENGINEERING CONSULTANT SITE OBSERVATION

1.1 CONTRACTOR AND OWNER COORDINATION AND SCHEDULING

- A. Contractor Responsibilities are specified in Specification Section 01456.
- B. Owner’s Civil Engineering Consultant (CEC) will perform site observation at no cost to the Contractor.

1.2 CEC OBSERVATIONS

- A. CEC will perform observations in accordance with the Civil Engineering Consultant Special Observations Guideline located in the Design Collective at the Owner’s Bldg Portal website.
- B. Perform site observations as agreed to with the Owner as listed below or as otherwise requested by the Authority Having Jurisdiction or Owner’s Construction Manager to check a sample of the constructed Work for general conformance with the Contract Documents.
- C. Perform a minimum of the following site observations as outlined in the Owner’s Civil Engineering Consultant Special Observation Guidelines located on the Owner’s Bldg Portal website.
 1. First visit 16 to 18 weeks (or approximately 120 days) prior to possession.
 2. Second visit 8 to 9 weeks (or approximately 60 days) prior to possession.
 3. Third visit 1 to 2 weeks (or approximately 10 days) prior to possession.

[The following paragraph applies to accelerated, small format projects only (for both SWPPP and Site Related)]

- D. Perform a minimum of the site observations as follows for accelerated, small format projects as outlined in the Owner’s Civil Engineering Consultant Special Observation Guidelines located on the Owner’s Bldg Portal website.
 1. 60 days prior to the possession date.
 2. 14 days prior to the possession date.
 3. Date of possession.
- E. The observations listed above are the minimum number of observations to be performed. Additional visits as considered necessary by CEC as listed below shall also be performed by the CEC. Should there be outstanding items of non-conformance with the Contract Documents that warrant additional site observations to be performed by the CEC, the CEC shall receive approval from Owner prior to performing an additional site observation.

- F. Deviations from the Contract Documents shall be entered into the on-line Owner's Observation Log by the CEC as required and will be tracked and noted by the CEC when resolved by subsequent conformance by the Contractor.
- G. Observation Log: www.bldgportal.com, enter username and password, select Observation Log. Follow instructions on the Observation Log website.
- H. The CEC shall not have control over or responsibility for construction means, techniques, sequences of operations or for safety programs and procedures in connection with the construction work.
- I. Work will be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work

SECTION 02300 - EARTHWORK

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Testing and inspection shall be either continuous or periodic as defined in Part 1 of this Appendix and as follows:
 - 1. Continuous: Perform in areas supporting a structure including, but not limited to, building pad area, retaining walls, etc. When continuous testing and inspection is in progress, conduct testing and inspection in areas outside building pad or structure at the frequencies stated herein. This shall include, but not limited to, the CTL requesting and reviewing GC proofrolling documentation to assure correctness and completeness of proofrolling and any associated corrective actions taken by the Contractor.
 - 2. Periodic: In addition to continuous inspections specified above, perform unannounced periodic testing visits as follows when continuous testing is not being performed as described above:
 - a. Two days during the first week when earthwork starts in a paved area.
 - b. Two days each week thereafter until earthwork is complete.
 - c. For days when periodic testing is not provided, an Owner T&I Technician that is already on-site performing other tests and inspections, shall provide a daily, random observation of earthwork activities for general compliance with the specification.
- C. Test Frequency:
 - 1. Number of tests to be taken at each site visit shall be the test frequencies stated based on quantities or occurrences which have accumulated up to, in between, or during each periodic visit.
 - 2. Not less than one specified test shall be conducted each periodic visit when material has been placed since last visit.
 - 3. In addition, at least one specified test shall be conducted on work being placed during each periodic visit.
- D. Field testing, frequency, and methods may vary as determined by and between the Owner and the CTL.
- E. Work shall be performed by a Special Inspector – Technical I unless specified otherwise. Report of testing and inspection results shall be made upon the completion of testing.
- F. Classification of Materials: Perform test for classification of materials used and encountered during construction in accordance with ASTM D2488 and ASTM D2487.
- G. Laboratory Testing Of Materials: Perform laboratory testing of materials (Proctor, Sieve Analysis, Atterberg Limits, Consolidation Test, etc.) as specified.
- H. Proofrolling: Document and explain proofrolling inspection procedures and results in the laboratory inspection report.

- I. Field Density Tests
 - 1. Building Subgrade Areas, Including 5'-0" Outside of Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 sq. ft and at locations along all continuous wall footings with intervals not exceeding 100 feet and at each column spread footing. In fill areas, same rate of testing for each 8-inch lift, measured loose and at locations along continuous wall footings with intervals not exceeding 100 feet and at each column spread footing.
 - a. Density tests on top of building subgrade shall be performed within 48 hours prior to placement of overlying materials. If inclement weather occurs after testing, retest prior to placement of overlying materials.
 - 2. Paving Areas and other Areas of Construction Exclusive of Building Subgrade:
 - a. In cut areas, not less than one compaction test for every 10,000 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - b. Outparcels: In cut areas, not less than one compaction test for every 2,500 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - c. Utility Trench Backfill: Intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill.
 - 3. Test Method: In-place nuclear density, ASTM D6938.
- J. Observation and Inspection:
 - 1. Observe all subgrades/excavation bases below footings and slabs and verify design bearing capacity is achieved as required. Work shall be performed by a Special Inspector – Technical II.
 - 2. Observe and document presence of groundwater within excavations.

1.2 RETESTING AND RE-INSPECTION BY OWNER CTL

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

SECTION 02340 - SOIL STABILIZATION

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner’s Construction Testing Laboratory (CTL).
- B. Unconfined compression tests on lime, fly ash, or Portland cement treated mixture shall be conducted in accordance with ASTM D1633. Mold three specimens for each mix design submitted by the Contractor to verify mix design meets the specified requirements. Cure each specimen at a constant moisture content and temperature for 28 days. Test for unconfined compressive strength and compare to the specified design strength. Perform test minimum of three weeks prior to proposed stabilization activities.
- C. Field Density: Field in-place density shall be determined as specified in Appendix Section 02300.

SECTION 02715 - BASE COURSE

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner’s Construction Testing Laboratory (CTL).
- B. Testing and inspection shall be during unannounced visits on a periodic basis according to definition in Part 1 of this Appendix and as follows:
 - 1. One day when placement begins.
 - 2. One day when placement is approximately 25% complete.
 - 3. One day when placement is approximately 50% complete.
- C. Field testing, observation, and inspection shall be conducted only during the periodic site visits.

1. Test frequencies stated shall be based on quantities or occurrences which have accumulated up to, in between, and during each periodic visit.
 2. Not less than one specified test shall be conducted each periodic visit when material has been placed since last visit.
 3. In addition, at least one specified test shall be conducted on work being placed during each periodic visit.
- D. Field tests for in-place materials will be performed in accordance with the following:
1. Density: Nuclear Method, ASTM D6938. One test in each lift for each 20,000 sq. ft. of in-place base material area.
 2. Base Material Thickness: One test for each 20,000 sq. ft. of in-place base material area. All areas tested for thickness shall meet or exceed the base thickness shown on the drawings.
 3. Verify Contractor's measurements of base course elevation
- E. Prepare and distribute test reports as specified in Part 1 of this Appendix.

1.2 RETESTING AND RE-INSPECTION BY OWNER CTL

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

SECTION 02740 - ASPHALT CONCRETE PAVING

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. The testing and inspection shall be during unannounced visits on a periodic basis according to the definition in Part 1 above, and as follows:
1. One day on the day when the density control strip is placed.
 2. One day when pavement placement is approximately 25% complete.
 3. One day when pavement placement is approximately 50% complete.
- C. Field testing, observation, and inspection shall be conducted only during the periodic site visits except as required for subgrade testing for density control strip specified in PREPARATION paragraph in Specification Section 02740.
1. Number of tests to be taken at each site visit shall be the test frequencies stated based on quantities or occurrences which have accumulated up to, in between, or during each periodic visit.
 2. Not less than one specified test shall be conducted each periodic visit when material has been placed since last visit.
 3. In addition, at least one specified test shall be conducted on work being placed during each periodic visit.
- D. Core Sampling and Testing: Asphalt surface and base courses shall be randomly cored at minimum rate of 3 cores per day's placement per mix type, but not less than 3 cores in light duty areas and 3 cores in heavy-duty areas shall be obtained. In addition to cores taken during periodic site visits, sampling shall be performed at the rate of one sample per 1000 sq. yds., or fraction thereof, of pavement placed during the absence of the CTL. Asphalt concrete pavement samples shall be tested for conformance with density and thickness requirements. Cores shall be cut from minimal loading areas representative of project.
- E. Surface Smoothness Test: In areas of obvious depressions or bumps, suspect areas of each lift shall be checked with a 10'-0" straightedge both parallel with, and at right angles to, centerline of the paved area. The variation of the surface between two contact points shall not exceed 1/4-inch.
- F. Pavement Thickness: The CTL will measure thickness of each core sample taken. At each core location, the thickness of the course shall meet or exceed the thickness shown. If the thickness of a lower course of asphalt is less than the thickness shown, it shall be identified as a deviation and recorded. The Contractor shall either remove and replace the deficient pavement or increase the thickness of the upper course so that the total thickness of the pavement meets or exceeds the design thickness, provided that the specified compaction of the lower lift is achieved.

- G. Field Density Test For In-Place Materials:
 1. Density tests shall be conducted on each core sample taken in accordance with ASTM D1188 or D2726 (AASHTO T166, T275, T331) as applicable.
- H. Volumetric Properties: Perform testing as follows on samples provided by the Contractor:
 1. Superpave Mix: Compact into specimens in accordance with AASHTO T312. Test each specimen for determination of relative density, VMA, VFA, and dust-to-binder ratio.
 2. Marshall Mix: Compact into specimens using compactive blows equal to mix design per side with the Marshall hammer as described in AASHTO T245. Temperature shall be equal to temperature at paving machine with reheating. Test each specimen for determination of laboratory air voids, Marshall stability, and flow.
- I. Asphalt Content and Aggregate Gradation: Asphalt content extraction and gradation of extracted aggregate testing shall be performed in accordance with AASHTO T 308 or AASHTO T164 and ASTM D5444 respectively and local State Highway Department Specifications requirements. At least one asphalt content and one gradation test shall be taken for each 2000 tons or each day pavement is placed.

1.2 RETESTING AND RE-INSPECTION BY OWNER CTL

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

SECTION 02751 - CONCRETE PAVING

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner’s Construction Testing Laboratory (CTL).
- B. The testing and inspection shall be during unannounced visits on a periodic basis in accordance with definition in Part 1 of this Appendix and as follows:
 1. One day when pavement placement begins.
 2. One day when pavement placement is approximately 25% complete.
 3. One day when pavement placement is approximately 50% complete.
- C. Field testing, observation, and inspection shall be conducted only during the periodic site visits.
 1. Number of tests to be taken at each site visit shall be the test frequencies stated based on quantities or occurrences only as it occurs during each periodic visit.
 2. In addition, at least one specified test shall be conducted on work being placed during each periodic visit.
- D. Field testing, frequency, and methods may vary as determined by and between the Owner and the Owner’s Testing Laboratory.
- E. Review the Contractor's proposed materials and mix design for conformance with specifications.
- F. Perform testing in accordance with ACI 301 and testing standards listed herein.
- G. Strength Tests:
 1. Secure composite samples in accordance with ASTM C172. Sample at regularly spaced intervals from middle portion of the batch. Sampling time shall not exceed 15 minutes.
 2. Mold and cure specimens in accordance with ASTM C31.
 - a. A minimum of four concrete test cylinders shall be taken for every 100 cubic yards or less of each class of concrete placed each day and not less than once for each 5000 square feet of paved area.
 - b. During the initial 24 hours (plus or minus 8 hours) after molding, the temperature immediately adjacent to the specimens shall be maintained in the range of 60 to 80 degrees F. Control loss of moisture from the specimens by shielding from the direct rays of the sun and from radiant heating devices.
 - c. Specimens transported prior to 48 hours after molding shall not be demolded, but shall continue initial curing at 60 to 80 degrees F until time for transporting.

- d. Specimens transported after 48 hours age shall be demolded in 24 hours (plus or minus 8 hours). Curing shall then be continued but in saturated limewater at 73.4 degrees (plus or minus 3 degrees F) until the time of transporting.
- e. Wet cure cylinders under controlled temperature until testing.
- 3. Test cylinders in accordance with ASTM C39.
 - a. Size of specimen test cylinder shall be 6" x 12" or 4" x 8".
 - b. Date test cylinders and number consecutively. Give each cylinder of each set an identifying letter (i.e. A, B, C, D). Prepare a sketch of the site plan for each test set identifying location of placed concrete.
 - c. Test one cylinder (A) at 7 days for information..
 - d. Test two cylinders (B and C) at 28 days and the average of the breaks shall constitute the compressive strength of the concrete sample.
 - e. Retain fourth cylinder (D) for further testing if needed, but do not retain cylinder more than 90 days.
- 4. Evaluation and Acceptance:
 - a. Strength level of concrete will be considered satisfactory if the average of all sets of three consecutive strength tests equal or exceed specified strength and no individual strength test (average of two cylinders) results are below specified compressive strength by more than 500 psi.
 - b. Complete concrete work will not be accepted unless requirements of ACI 301, have been met, including dimensional tolerances, appearance, and strength of structure.
 - c. Where average strength of cylinders, as shown by tests is not satisfactory, Owner reserves the right to require Contractor to provide improved curing conditions of temperature and moisture to secure required strength. If average strength of laboratory control cylinders should fall so low as to cause portions of structure to be in question by Owner, follow core procedure set forth in ASTM C42. If results of core test indicate, in opinion of Owner, that strength of structure is inadequate, provide without additional cost to Owner, replacement, load testing, or strengthening as may be ordered by Owner. If core tests are so ordered and results of such tests disclose that strength of structure is as required, cost of test will be paid by Owner.
- H. Slump Test: Conduct slump test for each cylinder set taken in accordance with ASTM C143. Make additional slump tests for every other load from a stationary mixer or truck to test consistency. Sampling shall be in accordance with ASTM C172.
- I. Air Content: Conduct air content test for each cylinder set for concrete in accordance with ASTM C 231, ASTM C 173, or ASTM C 138. Indicate test method on report. Make test at same time as slump test.
 - 1. Perform air content test for first and second truck for each class of concrete placed each day. If either test fails, perform air test on every truck until two consecutive air tests comply with the requirements of the project specifications.
- J. Unit Weight: ASTM C 138.
- K. Temperature Test: Conduct temperature test for each cylinder set taken in accordance with ASTM C1064. Test hourly when air temperature is 40 F and below or 80 F and above. Determine temperature of concrete sample and ambient air for each strength test.
- L. In addition to required information noted previously in this Section, record the following information on concrete compression reports:
 - 1. Test cylinder number and letter.
 - 2. Specific foundations or structures covered by this test.
 - 3. Proportions of concrete mix or mix identification.
 - 4. Maximum size coarse aggregate.
 - 5. Specified compressive strength.
 - 6. Tested compressive strength.
 - 7. Slump, air-content.
 - 8. Concrete plastic unit weight.
 - 9. Concrete Temperature.
 - 10. Elapsed time from batching at plant to discharge from delivery truck at project.

11. Date and time concrete was placed.
 12. Ambient temperature, wind speed, and relative humidity during concrete placement.
 13. Name of technician securing samples.
 14. Curing conditions for concrete strength test specimens (field and laboratory).
 15. Date strength specimens transported to laboratory.
 16. Age of strength specimens when tested.
 17. Type of fracture during test.
- M. At the start of each day's mixing, report any significant deviations from approved mix design including temperature, moisture and condition of aggregate.
- N. Review each delivery ticket of concrete. Report type of concrete delivered, amount of water added and time at which cement and aggregate were loaded into truck, and time at which concrete was discharged from truck
- O. In Place Pavement Testing:
1. Randomly core pavement during periodic site visits. Sampling shall be performed at the rate of one sample per 1000 sq. yds., or fraction thereof, of pavement placed during the absence of the CTL. Sample and test cores in accordance with ASTM C42. Core will be tested for thickness and quality of aggregate distribution. Core holes shall be patched by the Contractor immediately with Portland cement concrete and shall be finished to provide level surface as specified herein.
 2. Establish and maintain required lines and elevations.
 3. Check surface areas at intervals necessary to eliminate ponding areas.
- P. Additional Tests: Additional in-place tests shall be conducted as directed by the Wal-Mart Construction Manager when specified concrete strengths and other characteristics have not been attained in the structures.

SECTION 02900 – PLANTING

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. The Contractor shall provide imported topsoil analysis as specified in Specification Section 02900.
- C. The CTL will perform topsoil testing for verification of depth of topsoil placement as follows:
 1. Open Lawn Areas: Test at 50 feet on center, minimum 1 inspection per area
 2. Parking Islands: One test per 200 square feet of sod and seed bed preparation area, minimum one per island.
 3. Submit test reports in accordance with requirements in Part 1 of this Appendix.

SECTION 03311 – SITE STRUCTURAL CONCRETE

1.2 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Exterior Light Pole Bases: Make cylinder sets for compressive strength testing once at beginning of base placement each day light pole base concrete is placed. Mold, cure, and test samples in accordance with the Strength Tests requirements in Section 02751 within this Appendix B. No additional testing is required for light pole bases.

END OF SECTION

APPENDIX B – TESTING, INSPECTION, AND OBSERVATION BY OWNER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for Owner’s quality control. Refer to Civil Specifications manual for site work Appendix B requirements.
- B. Owner’s testing, inspection, and observation services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- C. Unless otherwise specified, provisions specified herein are included as requirements for Owner’s Construction Testing Laboratory (CTL), Owner’s consultants, or other testing or inspections agencies hired by the Owner and shall be considered information only to Contractor.
 - 1. Refer to Article 2.1 for list of Sections containing responsibilities of Owner’s Construction Testing Laboratory (CTL).
 - 2. Refer to Article 2.2 for list of Sections containing responsibilities of Owner’s consultants or other testing or inspections agencies.
- D. Related Requirements:
 - 1. Construction Contract between Walmart and Contractor: Inspections, testing, and approvals required by public authorities. Contractor obligations to perform work in accordance with Contract Documents.
 - 2. Section 01452 - Contractor Quality Control: Administrative and procedural requirements for Contractor quality assurance and quality control.

1.2 REFERENCES

- A. Refer to end of Section for list. Publications are referred to within the text by the basic designation only.

1.3 DEFINITIONS

- A. Testing: Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.
- B. Inspection: Evaluation of systems primarily requiring observation and engineering judgment.
- C. Observation: Evaluation of systems primarily requiring observation and professional judgment.
- D. Quality Assurance: Activities, actions, and procedures performed by the Contractor before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will substantially comply with construction documents.
- E. Quality Control: Tests, inspections, procedures, and related actions performed by the Contractor during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction substantially comply with construction documents.
- F. Construction Testing Laboratory (CTL): The independent testing and inspection agency employed by the Owner.
- G. Contractor: The General (prime) Contractor for the Project. Also referred to as GC.
- H. Architect of Record (AOR): The prime consultant in charge of overall design and coordination of the building.
- I. Engineer of Record (EOR): The Registered Engineer in responsible charge of engineering design for the project.

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- J. Refrigeration Engineer of Record (REOR): The registered engineer in responsible charge of refrigeration engineering design for the project.
- K. Structural Engineer of Record (SER): The Registered Engineer in responsible charge of the structural design for the project.
- L. Civil Engineering Consultant (CEC): The Registered Engineer in responsible charge of the civil design for the project. Refer to the Civil Specifications manual.
- M. Fire Protection Consultant: Consultant that provides professional design services and construction documents related to fire protection for the project.
- N. Architect - Engineer (A/E): A collective term to include the AOR, CEC, SER, and the Mechanical, Electrical, and Fire Protection EOR.
- O. Independent Test and Balance Agency (ITBA): The Independent HVAC test and balance company employed by the Owner.
- P. Building Official: The Officer or his duly authorized representative charged with the administration and enforcement of the local building code.
- Q. Special Inspector (SI): The Special Inspector under the direct supervision of a registered civil/structural engineer (unless otherwise specified) regularly engaged in inspection, and experienced with the type of work requiring related testing and inspection. The categories of special inspector are:
 1. Technical I (TI): A Technician who is an employee of a qualified and approved testing laboratory. Lab work shall be performed in a qualified testing laboratory.
 2. Technical II (TII): A Technician with a minimum of 2 years' experience, or a graduate engineer, and is an employee of a qualified and approved testing laboratory.
 3. Technical III (TIII): An engineer regularly engaged in related work with a minimum of 4 years of experience, licensed in the State in which the project is located, and is an employee of a qualified and approved testing laboratory. This licensed engineer shall review and approve all final field reports.
 4. Structural I (StI): A graduate civil/structural engineer, or other trained and experienced personnel acceptable to the SER, with experience in the testing and inspection of related structural systems.
 5. Structural II (StII): A civil/structural engineer regularly engaged in related work with a minimum of 4 years of experience, licensed in the State in which the project is located. The licensed engineer shall review and approve all inspection reports.
 6. Independent Roofing Inspector (IRI): A technician employed or subcontracted by the CTL for the purpose of field observation of roofing installation. The IRI shall be certified as a Registered Roofing Observer (RRO) by the Institute of Roofing, Waterproofing, and Building Envelope Professionals (RCI) (Formerly Roof Consultants Institute).
 7. Roofing Technician: A technician employed by the CTL with training and experience in roofing construction or inspection. The Roofing Technician shall be under the direct supervision of the IRI and shall provide continuous inspection during roofing work.
 8. Unique special inspector requirements, for specific materials and system, are noted in related technical specification sections.
- R. Continuous Inspection: The full-time observation of work requiring inspection by an approved Special Inspector who is present in the area where the work is being performed.
- S. Periodic Inspection: The part-time or intermittent observation of work requiring inspection by an approved Special Inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- T. Deviation: Any item or component of work that does not substantially conform to the requirements of the construction plans and/or specifications and which has not been corrected by the end of business on the day it is identified. A life-safety deviation is any construction deviation that poses a serious hazard to any person.

1.4 CONSTRUCTION TESTING LABORATORY (CTL) QUALITY REQUIREMENTS

- A. CTL shall comply with requirements of ASTM C 1077, ASTM C 1093, ASTM D 3740, ASTM D 3666, ASTM E 329, ASTM E 543, ASTM E 699, and AASHTO R18.
- B. CTL shall be authorized to operate in state in which Project is located.
- C. CTL Testing Equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either National Institute of Standards and Technology (NIST) standards or accepted values of natural physical constants.
- D. CTL shall have and maintain a written Quality Manual (QM) for its laboratory conforming to the Appendix requirements ASTM E 329 or AASHTO R18. The QM shall be available for review by the Owner's Construction Manager upon request. The QM shall be organized similar to Quality Manual Requirements of AASHTO R18 and include the following:
 - 1. Organization and Organizational Policies.
 - 2. Staff.
 - 3. Equipment.
 - 4. Test Data Control and Reports.
 - 5. Diagnostic and Corrective Action.
 - 6. Internal Quality System Review.
 - 7. Subcontracting.
 - 8. Statement certifying compliance with ASTM standards specified above.

1.5 OWNER RESPONSIBILITIES

- A. Employment and payment for services of the Construction Testing Laboratory (CTL), Special Inspector (SI), and other third party testing, inspection, and observation firms to perform specified testing and inspecting will be by the Owner under separate contract.
- B. The Owner will perform testing and inspection (T & I) but only as a means to satisfy the Owner of contract compliance and as assurance to the Owner of Contractor quality control performance.
- C. Owner T&I specified herein below will be performed by the Owner's Construction Testing Laboratory (CTL) unless otherwise specified.

1.6 CONSTRUCTION TESTING LABORATORY AND SPECIAL INSPECTOR RESPONSIBILITIES

- A. Responsibilities include inspections, tests, and related actions including reports performed by testing or inspection service. They do not include Contract enforcement activities performed by the Owner's Construction Manager or authorities having jurisdiction.
 - 1. Provide the Architect of Record a copy of the contractual provisions defining the CTL's and SI's scope of services.
- B. The CTL/SI representative shall attend a pre-construction meeting prior to actual start of the Project. Except for the roofing inspection, the CTL/SI representative shall be the Registered Professional Engineer assigned to the project.
- C. Maintain a copy of Contract Drawings and Specifications with all Addenda and Change Orders. Use the Contract Documents supplemented by the approved shop drawings and applicable material and workmanship provisions of the Code for testing and inspection of the work.
- D. Provide qualified personnel at site to comply with schedule and submit reports for each test and inspection as defined hereinafter. Testing and inspection, except roofing inspection, shall be under supervision of the Registered Professional Engineer (P.E.) in the state where Project is located.
- E. Perform specified inspection, sampling, and testing of work, materials, and equipment in accordance with specified standards.

- F. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- G. Perform testing and inspections in a timely manner to avoid delay of work. Schedule and coordinate testing and inspections with Contractor and appropriate sub-contractors and installers.
- H. Coordinate and consolidate specified testing and inspection to be concurrent, to the maximum extent practicable, during each required site visit in order to minimize number of visits.
- I. If observed deviations from the Contract Drawings, Specifications, or building code will be probable cause of subsequent rejection of work or material, notify Contractor, the Owner's Construction Manager, Sitework Engineering Consultant, and Architect of Record, sufficiently in advance for determination to continue operations or take corrective measures before continuing. If uncorrected after a reasonable period of time, bring the situation to the attention of the Structural Engineer of Record, the Building Official, and to the Architect of Record.
- J. Track resolutions and remedial repairs to deviations and subsequent conformance to the Contract Documents on the Observation Log.
- K. Report any observed life safety issue immediately to Contractor and Owner's Construction Manager. After notification is given to the Contractor and the Owner's Construction Manager, the CTL/SI shall also log the life safety issue on Owner's Observation Log.
- L. Perform retesting due to non-conformance with the Contract Documents based on CTL testing.
- M. Provide a final conformance letter to Owner, SER, AOR and, if determined to be required, the AHJ. An example is attached at the end of this Appendix. CTL shall upload an electronic copy (pdf) to the Walmart Workspace in the Walmart Building Portal (www.bldgportal.com), CTL Reports/Letter of Conformance. CTL shall upload an electronic copy (pdf) to the Walmart Workspace in the Walmart Building Portal (www.bldgportal.com), CTL Reports/Letter of Conformance
- N. Testing and inspection by the Building Official do not preclude the normal field involvement and site observations by Architect or Structural Engineer of Record, nor shall it relieve the Contractor of any responsibility to complete the work in accordance with the approved drawings and specifications.
- O. Construction Testing Laboratory And Special Inspector Limits On Authority: The CTL or SI may not:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Assume any duties of Contractor.
 - 4. Stop the Work.
- P. Testing and inspecting services performed by the CTL (Construction Testing Laboratory) are required to verify compliance with requirements specified or indicated.
 - 1. CTL services do not relieve Contractor of responsibility for compliance with the Contract Document requirements nor limit Contractor's quality assurance and quality control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Specific testing and inspection requirements for individual construction activities shall be as specified in the individual Appendix Sections.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction do not limit responsibilities of the CTL.

1.7 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with CTL/SI and other third party personnel, and provide access to the Work and to manufacturer's facilities.
- B. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and to provide storage and curing of test samples. Provide lift equipment as required for inspection personnel of the Owner or the Owner's representatives.

- C. Provide CTL 24 hour notice prior to expected time for operations requiring inspecting and testing services.
- D. Notify in writing the Owner's Construction Manager three working days prior to expected time for operations requiring inspecting and testing services.
- E. Provide the CTL/SI with access to the internet for the purpose of logging deviations onto the Wal-Mart Observation Log on the Wal-Mart Building Portal website.

1.8 REPORTS

- A. The CTL or other Owner's testing or inspection firm shall submit reports for T&I and other items as required herein.
- B. CTL Information: Testing laboratory name, address, and telephone number, and names of full time Registered Engineer and responsible officer.
- C. Roof Observation Program.
- D. Test and Inspection Reports:
 - 1. Submit test and inspection reports showing the following information:
 - a. Date issued.
 - b. Project title and number.
 - c. Facility number.
 - d. Firm name, address and telephone number
 - e. Name of responsible officer(s).
 - f. Name and signature of tester or inspector.
 - g. Name and seal of registered engineer in responsible charge (as applicable).
 - h. Date and time of sampling.
 - i. Date of test or inspection.
 - j. Identification of product and specification section.
 - k. Location in project, including elevations, grid location and detail.
 - l. Type of test or inspections.
 - m. Results of tests or inspections and interpretation of same.
 - n. Observations regarding compliance with Contract Documents or deviations therefrom.
- E. Submit required reports and other items to the following:
 - 1. CEC: 1 copy. (Site work T&I only). Refer to Civil Specifications for submittal requirements.
 - 2. SER: 1 copy (Construction Administration Leader) (Bldg T&I only)
 - 3. AOR: 2 copies (Construction Administration Leader).
 - 4. Contractor: 3 copies.
 - 5. Building Official: Quantities as required.
- F. Submit a separate final signed report stating the work requiring inspection is, to the best of the inspector's knowledge, in conformance with the Contract Documents.
- G. Reports shall be made on 8-1/2 by 11 white paper, suitable for photocopying and binding in booklet form. Sheets shall have the testing/inspection firm's letterhead (including phone number and address). Larger sheets shall be folded and bound into the booklet.
- H. Submit Test and Inspection Reports within 3 working days of T&I occurrence. CTL shall also upload an electronic copy (pdf) to the Walmart Workspace in the Walmart Building Portal (www.bldgportal.com), CTL Reports.
- I. Tests and inspections indicating non-conformance (deviations) to the Contract Documents shall be brought to the attention of the Contractor, Sitework Engineering Consultant, and Architect of Record upon discovery in the form of hard copy reports and entered into the Wal-Mart Observation Log within 24 hours.

- J. Deviations from the Contract Documents, as defined above, shall be logged onto the Wal-Mart Observation Log by the CTL/SI representative on site. (www.bldgportal.com), enter username and password, select Observation Log. Follow instructions on the Observation Log website for entry of information.
- K. Owner's Construction Manager in conjunction with the CTL and/or SI will determine when to involve the AOR or EOR for remedial action.

PART 2 - and PART 3 - PRODUCTS and EXECUTION

2.1 TESTING AND INSPECTION BY OWNERS CONSTRUCTION TESTING LABORATORY (CTL)

- A. General Requirements: Testing and inspection by CTL shall be conducted as specified hereinafter listed by sections corresponding to section numbers of the Specifications. Where Section is included in CTL scope (noted by checked 'Y' box), refer to individual Section requirements specified hereinafter.
 - 1. Section 03310 - Structural Concrete and Exterior Concrete Slabs Y N
 - 2. Section 03314 – Interior Cast-in-Place Concrete Slabs Y N
 - 3. Section 03410 – Plant Precast Structural Concrete Panels Y N
 - 4. Section 05090 - Post-Installed Concrete and Masonry Anchors Y N
 - 5. Section 05120 - Structural Steel Y N
 - 6. Section 05300 - Metal Deck Y N
 - 7. Section 05400 - Cold Formed Metal Framing Y N
 - 8. Section 05510 – Metal Stairs with Handrails Y N
 - 9. Section 05520 – Metal Pipe and Tube Railings Y N
 - 10. Section 09511 - Acoustical Panel Ceilings Y N
 - 11. Tests and inspections shall, as a minimum, be performed by Technical I (TI) inspector if not otherwise specified in the individual section.
 - 12. If inspection of fabricators' work is required, the Owner's representative may require testing and inspection of the work at the plant before shipment.
 - 13. Testing and inspection shall be performed in accordance with the industry standard used as the reference for the specific material or procedure unless other criteria are specified. In the absence of a referenced standard, tests shall be accomplished in accordance with generally accepted industry standards.
 - 14. Work shall be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work.
- B. Testing or inspection in addition to that specified herein, may be performed by the CTL as directed by the Owner for in-place work as further verification of Work or as verification of Contractor performed Quality Control testing and inspection.

2.2 OBSERVATION BY PROFESSIONALS OF RECORD

- A. Observation by Owner's Professionals of Record (POR). Professionals of Record include the following as defined in Part 1:
 - 1. Architect (AOR)
 - 2. Structural Engineer (SER)
 - 3. Mechanical or Electrical Engineer (EOR)
 - 4. Fire Protection Engineer (EOR)
- B. Sections herein related to POR observation include the following (refer to individual Section requirements specified hereinafter):
 - 1. Section 01454 - Architect Engineer Site Observation
 - 2. Section 13900 - Fire Suppression

2.3 TESTING, INSPECTION, AND OBSERVATION BY OWNER'S INDEPENDENT INSPECTORS

- A. Sections herein which include testing, inspection or observation by Owner hired independent entities include the following (refer to individual Section requirements specified hereinafter):
 - 1. Section 07500 - Membrane Roofing: Owner's Independent Roofing Inspector (IRI).
 - 2. Section 16050 – Basic Electrical Materials and Methods: Owner's Independent Power Systems Study Consultant (PSSC).

SECTION 01454 - ARCHITECT-ENGINEER SITE OBSERVATION

2.1 CONTRACTOR AND OWNER COORDINATION AND SCHEDULING

- A. Contractor Responsibilities are specified in Specification Section 01454.
- B. Owner's Architect-Engineers (A/E) will perform site observation at no cost to the Contractor.

2.2 QUALITY ASSURANCE OBSERVATION

- A. The A/E will perform construction site observations as agreed to with the Owner as listed below or as otherwise requested by the Authority Having Jurisdiction or Owner's Construction Manager to check a sample of the constructed Work for general conformance with the Contract Documents.
- B. Owner's A/E Consultant Quality Assurance Observation Schedule:
 - 1. AOR:
 - a. Observations as required by the Authority Having Jurisdiction or as directed by Owner.
 - 2. EOR:
 - a. Observations as required by the Authority Having Jurisdiction or as directed by Owner.
 - 3. SER:
 - a. Observations as required by the Authority Having Jurisdiction or as directed by Owner.
 - 4. Fire Protection Consultant:
 - a. One week prior to date of construction completion. Refer to Section 13900.
- C. Specific items to be witnessed during the construction site observation (including but not limited to) are listed below in more detail by discipline to assist in scheduling the site observation at the proper time.
- D. Architectural: Architectural consultant site observation shall be by a competent representative of the AOR having complete knowledge of the project.
 - 1. Observe construction in progress and work completed, to determine if project is being constructed to meet the requirements of the Construction Documents.
 - 2. Review architecturally related construction documents currently used by the Contractor to assure that revisions and Construction Change Directives are incorporated and executed.
 - 3. Complete Construction Observation Report and upload completed report and accompanying photographs to Sharepoint. Upload location is Store folder/Project folder/Store Planning & Construction/Construction Observation.
- E. Structural:
 - 1. Verify concrete reinforcing, foundation sizes, anchor bolt placement, structural steel members, structural steel connections, metal decking type, and metal decking attachment.
 - 2. Additional visits shall be as required to review repair of previous deviations.
- F. Fire Protection:
 - 1. Verify the fire sprinkler systems are in conformance with the Contract Documents and shop drawings, review sprinkler head locations, main and branchline installation, and system testing.

- G. The A/E shall monitor the construction schedule and coordinate with the Contractor at least 21 days prior to scheduled date of construction completion to schedule site visits to occur at the most appropriate time. The A/E shall notify the Contractor and Owner's Construction Manager 14 days in advance of the date and time of each scheduled site visit.
- H. Testing and inspections by the Building Official shall not preclude the normal field involvement and site observations by the A/E, nor will it relieve the Contractor of any responsibility to complete the work in accordance with the approved drawings and specifications.
- I. The A/E shall not have control over or responsibility for construction means, techniques, sequences of operations or for safety programs and procedures in connection with the construction work.
- J. Work will be checked as it progresses, but failure to detect defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work.

2.3 DEFICIENCY PROVISIONS

- A. The observation site visits listed above are to be performed at Owner's expense. Should there be outstanding items of non-conformance with the Contract Documents that warrant additional site visits to be performed by the A/Es, the A/Es shall receive approval from Owner prior to performing additional construction site observations until all deviations have been corrected by the Contractor and closed by the A/E. Reimbursement by the Contractor for costs for additional A/E site visits will be as specified in Section 01452.
- B. Deviations from the Contract Documents shall be entered into the on-line Wal-Mart Observation Log by the consultants as required and will be tracked and noted by the consultants when resolved by subsequent conformance by the Contractor.
 - 1. Observation Log: www.bldgportal.com, enter username and password, select Observation Log. Follow instructions on the Observation Log website.
- C. Deviations/observations noted by the AOR will be noted in the Construction Observation Report. Construction Observation Report and photos will be uploaded location in Sharepoint in Store folder/Project folder/Store Planning & Construction/Construction Observation.

SECTION 03310 - STRUCTURAL CONCRETE AND EXTERIOR CONCRETE SLABS

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. CTL will perform tests and inspections as specified herein and in Tables A and B hereinafter.
- C. CTL will keep records of the testing and inspections.
- D. CTL is neither authorized to change any specified requirement nor to approve any portion of the work.
- E. Failure to detect defective material or Work will neither prevent rejection when defects are discovered later nor will it obligate Owner to make final acceptance.
- F. Qualifications: Unless otherwise specified, work shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I. In addition to the Inspector and CTL qualifications specified in this Section, the following qualifications shall apply for all Cast-in-Place Concrete inspections.
 - 1. Technical I: ACI Certified Grade I inspector.
 - 2. Technical II: ACI Certified Grade II inspector.
 - 3. CTL: C.C.R.L. certification at the National Bureau of Standards. (For multi-story projects only).
 - 4. Lead technician shall have at least five years' experience in projects of this size and complexity.
 - 5. Other technicians shall have at least two years' experience.

- G. Review the Contractor's proposed materials and mix design for conformance with specifications.
- H. Perform testing and inspections in accordance with ACI 301 and testing standards listed in this Section.
- I. Field Testing:
 - 1. Compressive Strength: Make cylinder sets for compressive strength testing per ASTM C31 at the following frequency:
 - a. Building Foundations: Once each day a given mix design is placed, and not less than once for each 150 cubic yards of each mix placed each day, nor less than once for each 5,000 square feet of each mix for wall or slab surface area placed each day.
 - b. Retaining Walls. Once each day a given mix design is placed, and not less than once for each 150 cubic yards of each mix placed each day, nor less than once for each 5,000 square feet of each mix for wall surface area placed each day. Only one side of the wall shall be considered when calculating surface area.
 - 2. Slump, Air Content, Temperature and Unit Weight: Conduct slump, air content, temperature, and unit weight tests as follows:
 - a. Test Methods:
 - 1) Slump - ASTM C143.
 - 2) Air content - ASTM C173, C 231 or C 138. Indicate test method on report.
 - 3) Concrete materials temperature - ASTM C1064.
 - 4) Unit weight - ASTM C138.
 - b. Test Frequencies:
 - 1) Building Foundations: Conduct tests when concrete is sampled for compressive strength testing. Notify the Owner's Construction Manager upon failure of any second failing test.
 - 2) All Other Concrete Placed:
 - a) Perform slump and temperature tests for first truck load of concrete and every other truck thereafter. If the initial slump and temperature fails, make additional slump and temperature tests for every other load from a stationary mixer or truck to test consistency. Test temperature hourly when air temperature is 40 F and below or 80 F and above. Provide test reports to Owner's Construction Manager.
 - b) Perform air test for first truck and every 27cubic yards minimum thereafter. Make test at same time as slump test. If initial test fails, perform air test in every other load to insure consistency. Provide test reports to Owner's Construction Manager and other involved parties.
 - 3) When Type F fly ash is used and concrete is exposed to weather, perform air content test for first and second truck for each mix of concrete placed each day. If either test fails, perform air content test on every truckload until two consecutive air content tests comply with specified requirements.
 - 4) Conduct temperature test hourly when air temperature is 40 degrees F and below or 80 degrees F and above.
 - 5) Determine temperature of concrete sample and ambient air for each strength test.
 - 6) When pumping concrete, take samples for slump tests at point of delivery from pumping line in addition to first slump test noted above for concrete with mid-range or high-range water-reducer.
 - 3. Flexural Strength: Make beam sets for flexural strength testing per ASTM C78 at the following frequency:
 - a. Interior Slab on Grade: Once for each 2000 cubic yards of each mix placed.
 - b. Interior Slab on Metal Deck: Once for each 2000 cubic yards of each mix placed.
 - 4. Note trends of decreasing quality in concrete due to changing seasons, conditions of curing, or other causes and bring to attention of the Owner's Construction Manager. Report and log comments on Non-Conformance Correction Log.
 - 5. Report any significant deviations from approved mix design including temperature, moisture and condition of aggregate.
- J. Laboratory Testing Requirements:
 - 1. Test items such as reinforcing steel, aggregates, and other products suspected of not meeting specified requirement as directed by Owner's Construction Manager to verify compliance. Provide test report to Owner's Construction Manager. In-place tests in accordance with ASTM C 42 shall be conducted as directed

- by the Owner's Construction Manager when specified concrete strengths and other characteristics have not been attained in the structures.
2. In-place tests in accordance with ASTM C 42 shall be conducted as directed by the Owner's Construction Manager when specified concrete strength and other characteristics have not been attained in the structures.
 3. Strength Tests:
 - a. Secure composite samples in accordance with ASTM C 172. Sample at regularly spaced intervals from middle portion of the batch. Sampling time shall not exceed 15 minutes.
 - b. Mold and cure specimens in accordance with ASTM C 31.
 - 1) During the initial 24 hours (plus or minus 8 hours) after molding, the temperature immediately adjacent to the specimens shall be maintained in the range of 60 to 80 degrees F. Control loss of moisture from the specimens by shielding from the direct rays of the sun and from radiant heating devices.
 - 2) Specimens transported prior to 48 hours after molding shall not be demolded, but shall continue initial curing at 60 to 80 degrees F until time for transporting.
 - 3) Specimens transported after 48 hours age shall be demolded in 24 hours (plus or minus 8 hours). Curing shall then be continued but in saturated limewater at 73.4 degrees (plus or minus 3 degrees F) until the time of transporting.
 - 4) During transportation, protect the specimens with suitable cushioning material to prevent damage from jarring. During cold weather, protect specimens from freezing with suitable insulation material. Transportation time shall not exceed four hours.
 - 5) Date test cylinders and number consecutively. Give each cylinder of each set an identifying letter (i.e. A, B, C, D). Prepare a sketch of the building plan for each test set identifying location of placed concrete.
 - c. Test cylinders in accordance with ASTM C 39.
 - 1) Test one cylinder (A) at 7 days for information. If the compressive strength of the concrete sample is equal to or above the 28 day specified strength, test another cylinder (B) at 7 days. The average of the breaks shall constitute the compressive strength of the concrete sample.
 - 2) Test two cylinders (B and C) at 28 days and the average of the breaks shall constitute the compressive strength of the concrete sample.
 - 3) Retain fourth cylinder (D) for further testing if needed, but do not retain cylinder more than 60 days.

K. Reporting:

1. Record the following information as applicable on reports and submit to Owner's Construction Manager and others as specified in this Section:
 - a. Test cylinder number and letter.
 - b. Specific foundations or structures covered by this test.
 - c. Proportions of concrete mix or mix identification.
 - d. Maximum size coarse aggregate.
 - e. Specified compressive strength.
 - f. Tested compressive strength.
 - g. Specified flexural strength.
 - h. Tested flexural strength.
 - i. Slump.
 - j. Air content.
 - k. Concrete temperature.
 - l. Concrete plastic unit weight.
 - m. Elapsed time from batching at plant to discharge from delivery truck at project.
 - n. Date and time concrete was placed.
 - o. Ambient temperature, wind speed, and relative humidity during concrete placement.
 - p. Name of technician securing samples.
 - q. Curing conditions for concrete strength test specimens (field and laboratory).
 - r. Date strength specimens transported to laboratory.
 - s. Age of strength specimens when tested.
 - t. Type of fracture during test.
2. Field Test Reports: Submit reports of field tests and inspections to Owner's Construction Manager and others as specified in this Section.

- L. Inspections: Conduct inspection below for pedestals, walls, and foundations supporting CMU, precast and concrete walls and retaining walls only.
1. Concrete Form Work:
 - a. Verify formwork dimensions will result in member size and configuration shown.
 - b. Structural adequacy of formwork is the sole responsibility of the Contractor.
 2. Concrete Reinforcement:
 - a. Verify reinforcing bar grade.
 - b. Verify reinforcing bars are free of dirt, excessive rust, and damage.
 - c. Verify reinforcing bars are adequately tied, chaired, and supported to prevent displacement during concrete placement.
 - d. Verify proper clear distances between bars and to surfaces of concrete.
 - e. Verify reinforcing bar size and placement.
 - f. Verify bar laps for proper length and stagger.
 3. Embedded Items:
 - a. Verify specified size, type, spacing, configuration, embedment length, and quantity of anchor bolts and embedded items.
 - b. Verify proper concrete placement and means have been taken to achieve consolidation around bolts and embedded items.
 4. Concrete Foundations Structural Inspections: Inspect foundations and report on the following:
 - a. Concrete footing size and depth.
 - b. Footing bar size, spacing, and placement (cover).
 - c. Placement and vibration of concrete.
 - d. Dowel bar size, orientation, embedment, and spacing.
 5. Concrete Mix:
 - a. Verify mixer truck trip ticket conforms to approved mix design.
 - b. Verify that total water added to mix on site does not exceed that allowed by concrete mix design.
 - c. Verify that concrete quality is indicative of adequate mixing time, consistency, and relevant time limits.
 - d. Work shall be performed by a Special Inspector - Technical I. Report of results shall be made daily.
 6. Preparation and Placement: Inspect preparation and placement of concrete.
 - a. Verify acceptable general condition of concrete base prior to placement.
 - b. Verify that concrete conveyance and depositing avoids segregation and contamination.
 - c. Verify that concrete is properly consolidated.
 - d. Verify reinforcement remains at proper location.
 7. Protection and Curing: Observe protection and curing methods.
 - a. Verify specified curing procedures are followed.
 - b. Verify that specified hot and cold weather procedures are followed.
 8. Inspection Frequencies: Inspection frequencies shall be as shown in Table B at the end of this Section.
- M. Testing and inspection visits for the various required testing and inspection shall be combined and coordinated to the greatest extent practicable to minimize number of visits.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

TABLE A - SECTION 03310 TESTING BY OWNER (CTL) SCHEDULE		
Description of Testing-Work	Frequency	Section Reference Appendix B - 03310
Compressive strength for building foundations supporting CMU, concrete, and precast walls; and retaining walls including sampling, molding, and curing concrete specimens.	Appendix B – 03310 Section 1.1.I	2.1.I.1 2.1.J.3

Air content, temperature, slump, and unit weight for building foundations supporting CMU, concrete, or precast walls; retaining walls		2.1.I.2
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**TABLE B - SECTION 03310
INSPECTION BY OWNER (CTL) SCHEDULE**

Description of Inspection Work	Frequency	Section Reference Appendix B - 03310
All inspections below shall apply only to building foundations supporting CMU, precast, and concrete foundations; and to retaining walls		
Concrete Form Work	One inspection at each formed concrete structural member prior to concrete placement.	2.1.L.1
Concrete Reinforcement.	One inspection at each concrete structural member prior to concrete placement.	2.1.L.2
Embedded Items	Periodic	2.1.L.3
Foundation Structural Inspection	One inspection at each concrete structural member prior to concrete placement.	2.1.L.4
Concrete Mix.	One inspection at each compressive cylinder test.	2.1.L.5
Preparation and Placement	Continuous throughout each concrete placement	2.1.L.6
Protection and Curing	One inspection per project	2.1.L.7

SECTION 03314 – INTERIOR CAST-IN-PLACE CONCRETE SLABS

2.3 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner’s Construction Testing Laboratory (CTL).
- B. Keep records of the testing and inspections.
- C. CTL is neither authorized to change any specified requirement nor to approve any portion of the work.
- D. Owner’s Concrete Consultant (SSI) is not authorized to change any specified requirement or to approve execution of any portion of the work.
- E. Failure to detect defective material or Work will neither prevent rejection when defects are discovered later nor will it obligate Owner to make final acceptance.
- F. Qualifications: Unless otherwise specified, work shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I. In addition to the Inspector and CTL qualifications specified in this Appendix, the following qualifications shall apply for all Cast-in-Place Concrete inspection.
 - 1. Technical I: ACI Certified Grade I inspector.
 - 2. Technical II: ACI Certified Grade II inspector.
 - 3. CTL: C.C.R.L. certification at the National Bureau of Standards. (For multi-story projects only)
 - 4. Lead technician shall have at least five years’ experience in projects of this size and complexity.
 - 5. Other technicians shall have at least two years’ experience.

- G. Review the Contractor's proposed materials and mix design for conformance with specifications.
- H. Perform testing in accordance with testing standards listed herein.
- I. Field Testing:
 - 6. Slump, Air Content, and Concrete Materials Temperature Tests:
 - a. Test Methods:
 - 1) Slump - ASTM C 143.
 - 2) Concrete materials temperature - ASTM C 1064.
 - 3) Air content - ASTM C 173 or C 231.
 - 4) Unit weight - ASTM C138.
 - 5) Compressive Strength- ASTM C31, 39
 - b. Periodic Test Frequencies:
 - 1) Conduct slump, air content, and temperature tests for the first placement of concrete and every 150 CY placed thereafter for each mix of concrete placed each day. If any test fails on the first placement, test at 50 CY for the corresponding failing test. If any test fails during normal 150 CY test intervals, test at next 50 CY for the corresponding failing test. Notify the Owner's Construction Manager upon failure of any second failing test.
 - 2) Make cylinder sets for compressive strength testing once each day a given mix design is placed, and not less than once for each 150 cubic yards of each mix placed each day, nor less than once for each 5,000 square feet of each mix for slab surface area placed each day.
 - 3) If pumping concrete is approved, take the same number of additional samples as noted herein for slump tests at point of delivery from pumping line.
 - 7. Flatness and Levelness Testing:
 - a. Test floor slab finished surface areas shown on drawings for flatness and levelness in accordance with ASTM E 1155, except as specified herein.
 - b. Perform testing at random on the first placement of the exposed sales floor slab and randomly on other placements as directed by the Owner's Construction Manager or as directed by Owner.
 - c. F-Number requirements shall be as follows for all interior sales floor slabs.
 - 4) FF /FL minimum overall for composite of measured values (SOV) for entire day's concrete placement; FF /FL minimum for any individual floor section (MLV) as specified in Tolerances paragraph.
 - d. Bound individual floor sections for testing purposes by the following that provide the smallest sections: construction joints, contraction joints or column and half-column lines.
 - e. Conform to F-numbers specified for floor areas within 2 feet of construction and isolation joints, in lieu of ASTM E 1155 requirements that exclude these areas.
 - f. Ensure top of entire floor falls within tolerances specified in Tolerances paragraph for finished floor elevation.
 - 8. Complete testing, identify defective areas, and give verbal report to Owner's Construction Manager within 24 hours after placement.
 - 9. Submit written report by electronic means or hand deliver to parties concerned within 36 hours or next regularly scheduled working day (Mon-Sat), after placement. Include costs for retesting replaced or repaired defective areas.
 - 10. Note trends of decreasing quality in concrete due to changing seasons, conditions of curing, or other causes and bring to attention of the Owner's Construction Manager. Report and log comments on Non-Conformance Correction Log.
 - 11. Verify each delivery ticket of concrete. Report type of concrete delivered, amount of water added and time at which cement and aggregate were loaded into truck, and time at which concrete was discharged from truck.
 - 12. Verify that the proper amount of densifier has been applied to the concrete floor slab surface.
- J. Laboratory Testing Requirements:
 - 13. Test items such as reinforcing steel, aggregates, and other products suspected of not meeting specified requirement as directed by Owner's Construction Manager to verify compliance. Provide test report to Owner's Construction Manager.
 - 14. In-place tests in accordance with ASTM C 42 shall be conducted as directed by the Owner's Construction Manager when specified concrete strengths and other characteristics have not been attained in the structures.
 - 15. Tests:

- a. Secure composite samples in accordance with ASTM C 172. Sample at regularly spaced intervals from middle portion of the batch. Sampling time shall not exceed 15 minutes.
 - b. Mold and cure specimens in accordance with ASTM C 31.
 - 1) During the initial 24 hours (plus or minus 8 hours) after molding, the temperature immediately adjacent to the specimens shall be maintained in the range of 60 to 80 degrees F. Control loss of moisture from the specimens by shielding from the direct rays of the sun and from radiant heating devices.
 - 2) Specimens transported prior to 48 hours after molding shall not be demolded, but shall continue initial curing at 60 to 80 degrees F until time for transporting.
 - 3) Specimens transported after 48 hours age shall be demolded in 24 hours (plus or minus 8 hours). Curing shall then be continued but in saturated limewater at 73.4 degrees (plus or minus 3 degrees F) until the time of transporting.
 - 4) During transportation, protect the specimens with suitable cushioning material to prevent damage from jarring. During cold weather, protect specimens from freezing with suitable insulation material. Transportation time shall not exceed four hours.
 - 5) Date test cylinders and number consecutively. Give each cylinder of each set an identifying letter (i.e. A, B, C, D). Prepare a sketch of the building plan for each test set identifying location of placed concrete.
 - c. Test cylinders in accordance with ASTM C 39.
 - 1) Test one cylinder (A) at 7 days for information. If the compressive strength of the concrete sample is equal to or above the 28 day specified strength, test another cylinder (B) at 7 days. The average of the breaks shall constitute the compressive strength of the concrete sample.
 - 2) Test two cylinders (B and C) at 28 days and the average of the breaks shall constitute the compressive strength of the concrete sample.
 - 3) Retain fourth cylinder (D) for further testing if needed, but do not retain cylinder more than 60 days.
- K. Reporting:
- 16. Record the following information on concrete material reports and submit to Owner's Construction Manager and others as specified hereinbefore.
 - a. Slump.
 - b. Air content.
 - c. Concrete temperature.
 - d. Concrete plastic unit weight.
 - e. Elapsed time from batching at plant to discharge from delivery truck at project.
 - f. Date and time concrete was placed.
 - g. Ambient temperature, wind speed, and relative humidity during concrete placement.
 - h. Name of technician performing tests.
 - i. Test cylinder number and letter.
 - j. Specific foundations or structures covered by this test.
 - k. Proportions of concrete mix or mix identification.
 - l. Maximum size coarse aggregate.
 - m. Specified compressive strength.
 - n. Tested compressive strength.
 - o. Curing conditions for concrete strength test specimens (field and laboratory).
 - p. Date strength specimens transported to laboratory.
 - q. Age of strength specimens when tested.
 - r. Type of fracture during test.
 - 17. Field Test Reports: Submit reports of field tests to Owner's Construction Manager and others as specified hereinbefore. In addition to other required information noted in this Section, record the following concrete materials information on "Wal-Mart Interior Slabs on Ground Observation Report":
 - a. Date and time concrete was placed.
 - b. Time of batching at plant (As shown on delivery ticket)
 - c. Relative humidity, ambient temperature, and base temperature during concrete placement in accordance with ACI 305.1.
 - d. Time of placing and finishing tasks at location where sampled concrete is placed.
 - 1) Discharge from delivery.
 - 2) Start of initial floating.

3) Start of initial troweling.

- L. Batch Plant Quality Control: Quality control of materials and batching operations during batching operations shall be the full responsibility of the batch plant operators. CTL or Owner's Concrete Consultant will not be required to perform observation, testing, or inspection at the batch plant during batching operations.

SECTION 03410 – PLANT-PRECAST STRUCTURAL CONCRETE PANELS

1.1 OWNER TESTING AND INSPECTION (T&I)

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL)
- B. Field welds will be visually inspected and nondestructively tested according to ASTM E 165 or ASTM E 709. All high-strength bolted connections shall be inspected.
- C. Observe and verify that the following are in accordance with specified requirements:
 - 1. Foundations for elevation, width, and general location.
 - 2. Grout proportioning.
 - 3. Hot and cold weather procedures.
- D. Provide periodic inspection of erection of precast concrete members by a Special Inspector – Technical I in compliance with the requirements of ACI 318: Ch. 26.
 - 1. At start of panel erection and at 50% and 75%.
- E. Visually inspect in-place panels for stress cracks or other damage or deficiency.
- F. Construction Testing Laboratory will prepare and report test results promptly and in writing to designated Building Official, Contractor, Structural Engineer, and Walmart Construction Manager

SECTION 05090 - POST-INSTALLED CONCRETE AND MASONRY ANCHORS

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- C. Section Includes:
 - 1. Post-installed mechanical and adhesive anchors for structural members, equipment supports.
- D. Periodically verify and inspect the following for each anchor specified in Section 05090:
 - 1. General compliance with manufacturer's published instructions.
 - 2. Product name and description.
 - 3. Adhesive expiration date for adhesive anchors.
 - 4. Compliance of drill bit with manufacturer's specifications.
 - 5. Adhesive application technique for adhesive anchors.
 - 6. Concrete type, compressive strength, and member thickness.
 - 7. Hole diameter, depth, location, and edge distance.
 - 8. Cleanliness of hole and anchor.
 - 9. Anchor diameter, length, and steel grade.
 - 10. Anchor embedment and spacing.
 - 11. Required tightening torque for mechanical anchors.
- E. Testing: Perform pullout or shear tests to determine adequacy of suspected malfunctioning anchors when directed to do so by the Owner's Construction Manager upon recommendation by the CTL.

SECTION 05120 - STRUCTURAL STEEL

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- C. In addition to the Special Inspector qualification stated in this Section, the Technical II Inspector shall be an American Society for Non-destructive Testing (ASNT) Non-destructive Testing Technician, TC-1A Level I, or an American Welding Society (AWS) Certified Associate Weld Inspector (C.A.W.I.)
- D. CTL shall report results after each observation visit.
- E. High Strength Bolting (Field Installed):
 - 1. General:
 - a. Visually inspect mating surfaces and bolt type for all slip-critical bolted connections prior to bolting.
 - b. Verify that bolts, nuts, washers, paint and installation/tightening standards are met.
 - c. Observe calibration procedures and verify that selected procedure is used to tighten bolts.
 - d. Test high strength bolted connections in accordance with bolting standard specified above.
 - 2. Slip Critical and Tension Bolts: Test bolt tightening in 100% of bolts. Verify that surfaces of connected elements have been brought into contact at 100% of connections. Verify all tips are removed from twist-off bolts.
 - 3. Bearing Bolts: Visually inspect to confirm surfaces of connected elements have been brought into contact, at 100% of connections. This shall apply only to bolts designed for values not requiring exclusion of threads from failure plane. All other bolts shall be tested as for tension bolts.
- F. High Strength Bolting (Shop Installed): Self performed by the Fabricator as part of their compliance with AISC Quality Certification Program - Category I requirements. For shop fabricated work, perform tests if more stringent requirements are required by either the AHJ or the SER. Shop bolting inspection requirements are same as field bolting requirements.
- G. Welding (General):
 - 1. Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to Building Official and SER.
 - 2. Verify qualifications of welders as AWS certified.
 - 3. Verify proposed welding procedures and materials.
 - 4. Verify adequate preparation of faying surfaces.
 - 5. Verify preheat and interpass temperatures of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- H. Welding (Field):
 - 1. Visible and uncovered at the time of each inspection for proper inspection procedures.
 - 2. Single Pass Fillet Welds: Visually inspect 100% of single pass fillet welds for size, length, and quality, per AWS D1.1.
 - 3. Multi-pass Fillet Welds: Visually inspect 100% of multi-pass fillet welds for size, length, and quality, per AWS D1.1.
 - 4. Partial Penetration Welds: Test 100% of partial penetration welds exceeding 5/16 inch, using Ultrasonic Testing per AWS. D1.1. Test 100% of partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 - 5. Complete Penetration Welds: Test 100% of complete penetration welds exceeding 5/16 inch, using Ultrasonic Testing per A.W.S. D1.1 Test 100% of complete penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 - 6. Miscellaneous Metals, Inserts and Prefabricated Components: Where integrity of the connections impact life safety or performance of the building structure, provide testing and inspection as for typical welds previously specified.

- I. Coordinate and schedule inspections such that completed bolts and welds are visible and uncovered at the time of each inspection for proper inspection procedures.
- J. Welding (Shop): Perform inspections as for field welding except weld testing may be reduced or deleted if fabrication shop satisfies AISC Quality Certification Program - Category I, or more stringent criteria, and is approved by Building Official and SER.
- K. Submittal Verification: Verify mill test reports and other submitted documentation for compliance with Contract Documents.
- L. Materials Verification: Verify materials delivered to Site comply with Contract Documents and approved shop drawings. Materials and verifications include:
 - 1. Structural Steel:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certified mill test reports.
 - 2. High Strength Bolts, Nuts, and Washers:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certificate of compliance.
 - 3. Welding Electrodes:
 - a. Identification markings to conform to AWS specification.
 - b. Manufacturer's certificate of compliance.
- M. Verification of Detail Compatibility.
 - 1. Inspection shall coincide with welding inspections.
 - 2. Review project documents affecting integrity of the structure, including Contract Documents and pertinent submittals including approved shop drawings.
 - 3. Perform review of the structure and visually confirm general compliance with Contract Documents.
 - 4. Inspect the following to verify member orientation, configuration, type, and size comply with details indicated in Contract Documents and approved shop drawings:
 - a. Bracing and stiffening members.
 - b. Structural member locations.
 - c. Proper applications of joint details at connections for structural members.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor. Retesting shall follow the procedures for correction of deficiencies described above.

SECTION 05300 - METAL DECK

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. If inspection of fabricator's work is required, testing agent may test and inspect structural steel at plant before shipment. Owner and SER reserve right to reject material not complying with Contract Documents at any time before final acceptance.
- C. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- D. CTL will prepare report of results after each observation visit and submit report to Owner.
- E. Metal Deck Fasteners:
 - 1. Visually inspect welded and screw fasteners for specified size, spacing, embedment, and location.
 - 2. Inspect 100% of side lap connectors over entire roof area for type, size, and spacing of side lap connectors. Verify that the side lap connection connects all layers of the deck tightly.

3. Inspect 100% of primary deck attachments to continuous steel members (joists, joist girders, and perimeter angles).
 4. For TEK screw connections, inspect for complete depth of penetration.
 5. For welded connections inspect for fusion and size.
- F. Coordinate and schedule inspections such that completed welds and fasteners are visible and uncovered at the time of each inspection for proper inspection procedures.
- G. Submittal Verification: Verify mill test reports and other submitted documentation, for compliance with Contract Documents.
- H. Materials Verification:
1. Verify materials delivered to Site comply with Contract Documents and approved shop drawings. Materials include:
 - a. Welding Electrodes:
 - b. Identification markings to conform to AWS specification.
 - c. Manufacturer's certificate of compliance.
 - d. Mechanical fasteners.
 - e. Deck: Select 6 random sheets for each type of deck used. Inspect for deck thickness, type, and material.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

SECTION 05400 - COLD FORMED METAL FRAMING

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- C. Welding (General):
1. Verify qualifications of all welders as AWS certified.
 2. Verify proposed welding procedures and materials.
 3. Verify adequate preparation of faying surfaces.
 4. Verify preheat and interpass temperatures of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- D. Welding (Field):
1. Cold Formed Metal Framing Welds: Visually inspect 100% of welds for specified length, size, and continuity in accordance with AWS D1.3 for metal less than 1/8" in thickness, for work designed as a structural element.
 2. Miscellaneous Metals, Inserts and Prefabricated Components: Where integrity of the connections impact life safety or performance of the building structure, provide testing and inspection as for typical welds previously specified.
- E. Welding (Shop): Perform inspections as for field welding except weld testing may be reduced or deleted if fabrication shop satisfies AISC Quality Certification Program - Category I, or more stringent criteria, and is approved by building official and SER.
- F. Miscellaneous Mechanical Fasteners: Visually inspect fasteners that are part of the building structural system for specified size, spacing, and location.
- G. Submittal Verification: Verify mill test reports and other submitted documentation for compliance with contract documents.

- H. Material Verification: Verify materials delivered to site comply with contract documents and approved shop drawings. Materials include:
 - 1. Welding Electrodes
 - a. Identification markings to conform to AWS specifications.
 - b. Manufacturer's certificate of compliance.
 - 2. Mechanical fasteners
- I. Coordinate and schedule inspections such that completed welds and fasteners are visible and uncovered at the time of each inspection for proper inspection procedures.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

SECTION 05510 – METAL STAIRS WITH HANDRAILS

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).
- B. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- C. In addition to the Special Inspector qualification stated in this Section, the Technical II Inspector shall be an American Society for Non-destructive Testing (ASNT) Non-destructive Testing Technician, TC-1A Level I, or an American Welding Society (AWS) Certified Associate Weld Inspector (C.A.W.I.)
- D. CTL shall report results after each observation visit.
- E. High Strength Bolting (Field Installed):
 - 1. General:
 - a. Visually inspect mating surfaces and bolt type for all slip-critical bolted connections prior to bolting.
 - b. Verify that bolts, nuts, washers, paint and installation/tightening standards are met.
 - c. Observe calibration procedures and verify that selected procedure is used to tighten bolts.
 - d. Test high strength bolted connections in accordance with bolting standard specified above.
 - 2. Slip Critical and Tension Bolts: Test bolt tightening in 100% of bolts. Verify that surfaces of connected elements have been brought into contact at 100% of connections. Verify all tips are removed from twist-off bolts.
 - 3. Bearing Bolts: Visually inspect to confirm surfaces of connected elements have been brought into contact, at 100% of connections. This shall apply only to bolts designed for values not requiring exclusion of threads from failure plane. All other bolts shall be tested as for tension bolts.
- F. High Strength Bolting (Shop Installed): Self performed by the Fabricator as part of their compliance with AISC Quality Certification Program - Category I requirements. For shop fabricated work, perform tests if more stringent requirements are required by either the AHJ or the SER. Shop bolting inspection requirements are same as field bolting requirements.
- G. Welding (General):
 - 1. Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to Building Official and SER.
 - 2. Verify qualifications of welders as AWS certified.
 - 3. Verify proposed welding procedures and materials.
 - 4. Verify adequate preparation of faying surfaces.
 - 5. Verify preheat and interpass temperatures of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- H. Welding (Field):
 - 1. Visible and uncovered at the time of each inspection for proper inspection procedures.

2. Single Pass Fillet Welds: Visually inspect 100% of single pass fillet welds for size, length, and quality, per AWS D1.1.
 3. Multi-pass Fillet Welds: Visually inspect 100% of multi-pass fillet welds for size, length, and quality, per AWS D1.1.
 4. Partial Penetration Welds: Test 100% of partial penetration welds exceeding 5/16 inch, using Ultrasonic Testing per AWS. D1.1. Test 100% of partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 5. Complete Penetration Welds: Test 100% of complete penetration welds exceeding 5/16 inch, using Ultrasonic Testing per A.W.S. D1.1 Test 100% of complete penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 6. Miscellaneous Metals, Inserts and Prefabricated Components: Where integrity of the connections impact life safety or performance of the building structure, provide testing and inspection as for typical welds previously specified.
- I. Coordinate and schedule inspections such that completed bolts and welds are visible and uncovered at the time of each inspection for proper inspection procedures.
 - J. Welding (Shop): Perform inspections as for field welding except weld testing may be reduced or deleted if fabrication shop satisfies AISC Quality Certification Program - Category I, or more stringent criteria, and is approved by Building Official and SER.
 - K. Submittal Verification: Verify mill test reports and other submitted documentation for compliance with Contract Documents.
 - L. Materials Verification: Verify materials delivered to Site comply with Contract Documents and approved shop drawings. Materials and verifications include:
 1. Structural Steel:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certified mill test reports.
 2. High Strength Bolts, Nuts, and Washers:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certificate of compliance.
 3. Welding Electrodes:
 - a. Identification markings to conform to AWS specification.
 - b. Manufacturer's certificate of compliance.
 - M. Verification of Detail Compatibility.
 1. Inspection shall coincide with welding inspections.
 2. Review project documents affecting integrity of the structure, including Contract Documents and pertinent submittals including approved shop drawings.
 3. Perform review of the structure and visually confirm general compliance with Contract Documents.
 4. Inspect the following to verify member orientation, configuration, type, and size comply with details indicated in Contract Documents and approved shop drawings:
 - a. Bracing and stiffening members.
 - b. Structural member locations.
 - c. Proper applications of joint details at connections for structural members.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor. Retesting shall follow the procedures for correction of deficiencies described above.

SECTION 05520 – METAL PIPE AND TUBE RAILINGS

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. Owner T&I will be performed by the Owner's Construction Testing Laboratory (CTL).

- B. Owner T&I shall be performed by a Special Inspector - Technical II or Special Inspector - Structural I.
- C. In addition to the Special Inspector qualification stated in this Section, the Technical II Inspector shall be an American Society for Non-destructive Testing (ASNT) Non-destructive Testing Technician, TC-1A Level I, or an American Welding Society (AWS) Certified Associate Weld Inspector (C.A.W.I.)
- D. CTL shall report results after each observation visit.
- E. High Strength Bolting (Field Installed):
 - 1. General:
 - a. Visually inspect mating surfaces and bolt type for all slip-critical bolted connections prior to bolting.
 - b. Verify that bolts, nuts, washers, paint and installation/tightening standards are met.
 - c. Observe calibration procedures and verify that selected procedure is used to tighten bolts.
 - d. Test high strength bolted connections in accordance with bolting standard specified above.
 - 2. Slip Critical and Tension Bolts: Test bolt tightening in 100% of bolts. Verify that surfaces of connected elements have been brought into contact at 100% of connections. Verify all tips are removed from twist-off bolts.
 - 3. Bearing Bolts: Visually inspect to confirm surfaces of connected elements have been brought into contact, at 100% of connections. This shall apply only to bolts designed for values not requiring exclusion of threads from failure plane. All other bolts shall be tested as for tension bolts.
- F. High Strength Bolting (Shop Installed): Self performed by the Fabricator as part of their compliance with AISC Quality Certification Program - Category I requirements. For shop fabricated work, perform tests if more stringent requirements are required by either the AHJ or the SER. Shop bolting inspection requirements are same as field bolting requirements.
- G. Welding (General):
 - 1. Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to Building Official and SER.
 - 2. Verify qualifications of welders as AWS certified.
 - 3. Verify proposed welding procedures and materials.
 - 4. Verify adequate preparation of faying surfaces.
 - 5. Verify preheat and interpass temperatures of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- H. Welding (Field):
 - 1. Visible and uncovered at the time of each inspection for proper inspection procedures.
 - 2. Single Pass Fillet Welds: Visually inspect 100% of single pass fillet welds for size, length, and quality, per AWS D1.1.
 - 3. Multi-pass Fillet Welds: Visually inspect 100% of multi-pass fillet welds for size, length, and quality, per AWS D1.1.
 - 4. Partial Penetration Welds: Test 100% of partial penetration welds exceeding 5/16 inch, using Ultrasonic Testing per AWS. D1.1. Test 100% of partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 - 5. Complete Penetration Welds: Test 100% of complete penetration welds exceeding 5/16 inch, using Ultrasonic Testing per A.W.S. D1.1 Test 100% of complete penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E 709, performed on root pass and on finished weld.
 - 6. Miscellaneous Metals, Inserts and Prefabricated Components: Where integrity of the connections impact life safety or performance of the building structure, provide testing and inspection as for typical welds previously specified.
- I. Coordinate and schedule inspections such that completed bolts and welds are visible and uncovered at the time of each inspection for proper inspection procedures.
- J. Welding (Shop): Perform inspections as for field welding except weld testing may be reduced or deleted if fabrication shop satisfies AISC Quality Certification Program - Category I, or more stringent criteria, and is approved by Building Official and SER.

- K. Submittal Verification: Verify mill test reports and other submitted documentation for compliance with Contract Documents.
- L. Materials Verification: Verify materials delivered to Site comply with Contract Documents and approved shop drawings. Materials and verifications include:
 - 1. Structural Steel:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certified mill test reports.
 - 2. High Strength Bolts, Nuts, and Washers:
 - a. Identification markings to conform to ASTM standards.
 - b. Manufacturer's certificate of compliance.
 - 3. Welding Electrodes:
 - a. Identification markings to conform to AWS specification.
 - b. Manufacturer's certificate of compliance.
- M. Verification of Detail Compatibility.
 - 1. Inspection shall coincide with welding inspections.
 - 2. Review project documents affecting integrity of the structure, including Contract Documents and pertinent submittals including approved shop drawings.
 - 3. Perform review of the structure and visually confirm general compliance with Contract Documents.
 - 4. Inspect the following to verify member orientation, configuration, type, and size comply with details indicated in Contract Documents and approved shop drawings:
 - a. Bracing and stiffening members.
 - b. Structural member locations.
 - c. Proper applications of joint details at connections for structural members.

2.2 RETESTING AND RE-INSPECTION BY OWNER CTL:

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor. Retesting shall follow the procedures for correction of deficiencies described above.

SECTION 07500 - MEMBRANE ROOFING

2.1 OWNER TESTING AND INSPECTION

- A. Roof Observation Program: The CTL will develop a comprehensive Roof Observation Program to be administered by the IRI. The Program is described in the "Roof Observation Program paragraph herein above.
- B. Roof Inspection:
 - 1. The Owner's Independent Roofing Inspector (IRI) will conduct roof inspections as specified herein. The IRI responsibilities will, in general, be as follows:
 - a. Provide full time inspection during roof installation.
 - b. Complete Roof Inspection Checklist.
 - c. Oversee remedial repairs in the field.
 - d. Enter roofing defects and required repairs defined as deviations by the IRC into the online Owner's Observation Log.
 - e. Issue Certification of Quality of Roof Construction upon completion of roof installation.
- C. The activities and responsibilities of the IRI shall not preclude any quality control responsibilities by the Contractor, the Roofing Contractor, or the Manufacturer's Technical Representative as specified herein.
- D. The IRI is neither authorized to change any specified requirement nor to approve any portion of the work.
- E. Failure to detect defective material or Work will neither prevent rejection when defects are discovered later nor will it obligate Owner to make final acceptance.

COMPREHENSIVE FINAL ROOF INSPECTION

INSTRUCTIONS

TOOLS AND SUPPLIES: Provide the following during inspections:

- Copy of roof plan and copy and specifications.
- Tape measure, metal thickness gauge, paint for marking defects on roof, roof coring tools and repair materials, and seam probe (to be supplied by Roofing Contractor).

INSPECTION PROCEDURE

- The Manufacturer's Technical Representative shall arrange and conduct inspection and complete checklist and identify defects and enter into Owner's Observation Log.
- All undersigned parties shall accompany inspection.
- Inspect underside of decking from inside of building for proper insulation fastener spacing and sheet fastener spacing.
- Roof Inspection shall start at the parapet wall on the GM side of the building, at the back corner.
- Proceed around perimeter.
- Continue across front wall and down sidewall at GR.
- Inspect metal flashings, roof edge fascia system, perimeter attachments, perimeter membrane sheet layout, parapet waterproofing membrane, and accessories.
- Inspect condition of paint on exterior walls. Inspect CMU for proper paint coverage.
- Inspect painted metals for proper coverage.
- Inspect back wall gutter or internal drainage system.
- Inspect field of roof system, beginning approx. 10 feet from back wall, walking side to side of building.
- Inspect roof area no more than 10 feet on each side of walking paths, from back, to front of building.
- Inspect checklist items at field seams, flashings, RTUs, mechanical equipment, skylights, refrigeration units, gas lines, expansion joints, crickets, walkpads, and other roof accessories.
- Mark defects on roof by paint markings and identify each defect using corresponding defect number.
- After roof inspection is complete, email signed inspection form to Owner's Construction Manager within 24 hours.

COMPLETION OF CHECKLIST AND DEFECTS FORM

- Answer each checklist item Yes or No.
- Mark "N/A" on checklist items which do not apply.
- Identify defects on the Owner's Observation Log. (www.bldgportal.com, enter username and password, select Observation Log)
- Number each defect as follows:
 - Identification Symbol-Checklist Item No.-Defect No. (E.g. MF-1-3)
 - Identification symbol and checklist item number shall correspond to the Roof Inspection Checklist. The defect number shall be numbered in sequence for each checklist item.
- Complete applicable information in the Observation Log including the resolution of each item.

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

2.1 OWNER TESTING AND INSPECTION (T&I):

- A. CTL shall perform periodic special inspection during installation of acoustical panel ceilings, including acoustical panel placement, ceiling grid suspension system installation and connection to structure.

END OF APPENDIX

REFERENCES

- B. American Association of State Highway and Transportation Officials (AASHTO)
1. AASHTO R18 - Establishing and Implementing a Quality System for Construction Materials Testing Laboratories.
 2. AASHTO T164 - Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA).
 3. AASHTO T166 - Bulk Specific Gravity (Gmb) of Compacted Hot-Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens.
 4. AASHTO T245 - Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
 5. AASHTO T275 - Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens.
 6. AASHTO T308 - Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method.
 7. AASHTO T312 - Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyrotory Compactor.
 8. AASHTO T318 - Water Content of Freshly Mixed Concrete Using Microwave Oven Drying (Formerly AASHTO TP 23)
 9. AASHTO T331 - Bulk Specific Gravity (Gmb) and Density of Compacted Hot Mix Asphalt (HMA) Using Automatic Vacuum Sealing Method.
- C. American Concrete Institute (ACI):
1. ACI 301 – Structural Concrete.
 2. ACI 305.1 - Hot Weather Concreting.
 3. ACI 318.14 – Building Code Requirements for Structural Concrete.
- D. ASTM International (ASTM):
1. ASTM C 31 - Making and Curing Concrete Test Specimens in the Field.
 2. ASTM C 39 - Concrete Specimens, Compressive Strength of.
 3. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 4. ASTM C 129 - Non-Load-Bearing Concrete Masonry Units.
 5. ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 6. ASTM C 140 – Standard Test Method for Sampling and Testing Concrete Masonry Units and Related Units.
 7. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 8. ASTM C 172 - Sampling Freshly Mixed Concrete.
 9. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 10. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
 11. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 12. ASTM C 318 - Gypsum Formboard
 1. ASTM C 1019 - Method of Sampling and Testing Grout.
 13. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.
 14. ASTM C 1077 - Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 15. ASTM C 1093 - Accreditation of Testing Agencies for Unit Masonry.
 16. ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils.
 17. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 18. ASTM D 1188 - Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
 19. ASTM D 1633 - Compressive Strength of Molded Soil-Cement Cylinders.
 20. ASTM D 2487 - Classification of Soils for Engineering Purposes.
 21. ASTM D 2488 - Description and Identification of Soils (Visual-Manual Procedure).
 22. ASTM D 2726 - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
 23. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

24. ASTM D 3740 - Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 25. ASTM D 3666 - Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
 2. ASTM D 5444 - Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
 3. ASTM D 6938 - In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 26. ASTM E 165 - Liquid Penetrant Examination for General Industry.
 27. ASTM E 329 - Agencies Engaged in the Testing and/or Inspection Of Materials Used in Construction.
 28. ASTM E 543 - Agencies Performing Nondestructive Testing.
 29. ASTM E 699 - Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E-6.
 30. ASTM E 709 - Magnetic Particle Testing.
 31. ASTM E 1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).
 4. ASTM F 1869 - Standard Test Method For Measuring Moisture Vapor Emission Rate Of Concrete Subfloor Using Anhydrous Calcium Chloride
- E. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code.
 2. AWS D1.3 - Structural Welding Code - Sheet Steel.
- F. Research Council on Structural Connections (RCSC):
1. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
- B. Masonry Standards Joint Committee (MSJC):
1. TMS 402/ACI 530/ASCE5 and TMS 602/ACI 530/ASCE 6 - Building Code Requirements and Specifications for Masonry Structures.
- C. National Fire Protection Association (NFPA):
1. NFPA 70E -Standard for Electrical Safety in the Workplace.

[Example Conformance Letter from Testing and Inspection Agency (CTL) - all items in parentheses are items to be edited for the project]

[Mr. Construction Manager]

Wal-Mart Construction
Sam M. Walton Development Complex
2001 S. E. 10th Street
Bentonville, Arkansas 72716

[Re: Supercenter (Store #xxx) - City, State]

[Dear Construction Manager:]

The purpose of this letter is to state to Wal-Mart, the Architect of Record and the Engineer of Record that, to the best of our knowledge, the construction on the above referenced project has been completed in substantial conformance with the approved Contract Documents and with the provisions of the applicable building code. In the capacity of owner's testing and inspecting agency, periodic reports as well as a final report have been issued. Those reports state that all of the on-site inspection and testing has been performed. Work requiring inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications, and applicable workmanship provisions of the code.

To our knowledge no outstanding items exist except as otherwise may be entered and shown on the Wal-Mart Observation Log.

Sincerely,

[Testing and Inspection Agency]

[Include a seal, signature and date of signature]

cc: [ARCHITECT OF RECORD]

[ENGINEER OF RECORD]



STANDARD SPECIFICATIONS

STANDARD SPECIFICATIONS INDEX

**CORRESPONDING
CALTRANS
SECTION NO.**

DESCRIPTION

**COS SPEC.
PAGE NO.**

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SECTION 1

DEFINITIONS AND TERMS

1-1.02A Abbreviations - (Organizational)

The following contains additions to Section 1-1.02A of the Caltrans Standard Specifications:

AAMA	Architectural Aluminum Manufacturer's Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMA	Acoustical Materials Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
Caltrans	State of California, Department of Transportation
CLFMI	Chain Link Fence Manufacturers Institute
CRA	California Redwood Association
COS	City of Stockton
CS	Commercial Standards
DEPA	Grade Trademark of American Plywood Association
EIA	Electronic Industries Association
ESO	Electrical Safety Orders
FHA	Federal Housing Administration
FS	Federal Specifications

GSA-FSS	General Services Administration-Federal Supply Services
IEEE	Institute of Electrical Electronics Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineers Association
MFMA	Maple Flooring Manufacturer's Association
MLMFA	Metal Lathe Manufacturer's Association
NBFU	National Board Fire Underwriters
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPDES	National Pollution Discharge Elimination System
PCA	Portland Cement Association
PLIB	Pacific Lumber Inspection Bureau
PUC	Public Utilities Commission
RWQCB	Regional Water Quality Control Board
SCPI	Structural Clay Products Institute
SDI	Steel Deck Institute
SJI	Steel Joist Institute
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resource Control Board
TCA	Tile Council of America
UBC	Uniform Building code - International Conference of Building Officials
UL	Underwriters's Laboratories, Inc.
USCE	United States Corps of Engineers
USC&GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WWPA	Western Wood Products Association

Reference in the Standard Specifications or special provisions to any of the publications of the above listed associations, organizations or authorities as a specification included, shall be taken to mean the latest current edition at time of bidding unless specifically stated otherwise.

1-1.02B Abbreviations (Word)

#4	1/2" Rebar
AB	Aggregate base
ABS	Acrylonitrile-butadiene-styrene
AC	Alternating current
AC	Asphalt concrete
ACP	Asbestos cement pipe
AKA	Also Known As
AMP	Ampere
AS	Aggregate sub-base
AV	Average
Ave	Avenue
BC	Beginning of curve
Blvd	Boulevard
BM	Bench mark
BMP	Best Management Practice
BTU	British Thermal Unit
BVC	Beginning of vertical curve
BWG	Birmingham Wire Gage (iron and steel wire)
CB	Catch basin
CC or C/C	Center to center
CF	Cubic feet
CFM	Cubic feet per minute
CFS	Cubic feet per second
CIP	Cast in place
CIPCP	Cast in place concrete pipe
CL or \mathcal{C}	Center line
cm	Centimeter
CMP	Corrugated metal pipe
Conc	Concrete
Const	Construct
Cu	Cubic
CY	Cubic yard
D	Diameter of pipe inside height of semi-elliptical conduit, or D-load
d	Penny
Deg.	Degree or degrees
DF	Douglas fir
Dia	Diameter
Dwg	Drawing
E	East
Ea	Each

EC..... End of curve
El or Elev Elevation
EP..... Edge of pavement
Eq..... Equation
ESCP..... Extra strength concrete pipe
EVC End of vertical curve
EW Each Way
Ex or Exist..... Existing
FC (or FOC) Face of Curb
FH Fire hydrant
FL or L Flow line
fpm Feet per minute
fps..... Feet per second
ft Foot or feet
g..... Gram
Ga Gauge
Gal Gallon
Galv Galvanized
General Permit General Construction Activity Storm Water Permit
GL..... Ground line
GPM Gallons per minute
Gr..... Grade
H High or height
HP Horsepower
HR..... Hour
Hor..... Horizontal
IN Instrument Number
IP..... Iron pipe
KVA..... Kilo Volt Amps
KW..... Kilowatts
L Length
Lb..... Pound
LF Linear foot
LH..... Lamp hole
LS Lump sum
Lin Linear
Long..... Longitudinal
Lt..... Left
M Meter
Max Maximum
MEP..... Maximum Extent Practicable
MFBM Thousand feet board measure
MGD Million gallons per day

MH..... Maintenance Hole
M Gal..... Thousand gallon
Mi Mile
Min Minimum
mm Millimeter
Mon..... Monument
N North
NE Northeast
NW Northwest
No Number
NOI Notice of Intent
OC..... On center
OG..... Original ground
OD..... Outside diameter
OR..... Official Records of County
Oz..... Ounce
PCC Point of compound curve or Portland Cement Concrete
PG&E Pacific Gas & Electric Co.
PI..... Point of intersection
P/L or R_L Property line
PP..... Power pole
pphm Parts per hundred million
ppm Parts per million
PRC Point of reverse curve
Prop..... Proposed
psf Pounds per square foot
psi Pounds per square inch
PT..... Point of tangency
PacBell..... Pacific Bell
PUE Public Utility Easement
PVC Polyvinyl chloride
Pvmt Pavement
Q Rate of flow or quantity
Qt..... Quart
R..... Radius
RP Reduced Pressure
RCP Reinforced concrete pipe
Rdwy Roadway
Ret Wall Retaining wall
Rt Right
R/W Right of way
S..... South or slope

San	Sanitary
SC	Sewer Connection
SD	Storm drain (aka Storm Sewer)
Sec	Seconds
SF	Square foot
SE	Southeast
Spec	Specifications (aka Standard Specifications)
Sq	Square
Sq Ft	Square foot
Sq Yd	Square yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
SY	Square Yard
SW	Southwest
SWPPP	Storm Water Pollution Prevention Plan
T	Tangent distance
Ta	Total Asphalt or Full Depth Asphalt
TBM	Temporary Bench Mark
V	Velocity of flow
VC	Vertical Curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
W/	With
WPJ	Weakened Plane Joint
WWF	Welded Wire Fabric
Yd	Yard or Yards

1-1.02C Symbols

E	Degree (s)
/	Per
%	Percent
'	Feet, Minutes
"	Inches, Seconds
x	By
@	At

1-1.03 Definitions

The following are additional definitions or definitions included in Caltrans Standard Specifications, which have been added to or modified for City of Stockton uses.

Acceptance - The formal written acceptance by the City of Stockton of an entire contract which has been completed in all respects in accordance with the Standard Specifications and Plans and any modifications thereof previously approved.

Arterial (Street Classification) - That part of the roadway system serving as the principal network for through traffic flow. The routes connect areas of principal traffic generation and important rural highways entering the city.

Classification questions should be directed to the Traffic Engineering Section of the Public Works Department of the City of Stockton.

Attorney General - This term is to be interpreted to mean the City Attorney for the City of Stockton.

Auxiliary Lane - That portion of the roadway adjoining the traveled way for speed change or other purposes supplementary to through traffic movement

California - Shall be interpreted to mean Stockton where it is used as a point of delivery.

California Storm Water Best Management Practice Handbooks;

Volume 1: Municipal BMP Handbook;

Volume 2: Commercial/Industrial BMP Handbook;

Volume 3: Construction BMP Handbook; - Refer to Chapter 13, Stockton Municipal Code

Caltrans - The State of California, Business & Transportation Agency, Department of Transportation.

City - The City of Stockton, California.

City Attorney - The City Attorney of the City of Stockton. Any reference to the Attorney General in Caltrans specifications shall mean the City Attorney of the City of Stockton.

City Council - The Stockton City Council.

Code - The terms Government Code, Labor Code, etc. refer to codes of the State of California.

Collector (Street Classification) - A collector street is defined as a street which serves traffic movements within subdivision and connects this area with an arterial street or other collector street.

Classification questions should be directed to the Traffic Engineering Section of the Public Works Department of the City of Stockton.

Commercial - Refer to Chapter 16 of the Stockton Municipal Code.

Contract Price - The total amount of money for which the contract is awarded.

Contract Unit Price - The contractor's original bid for a single unit of an item of work in the Proposal.

Days - Unless otherwise designated, days as used in the Standard Specification will be understood to mean working days.

Deeplift Asphalt Concrete - (See Full Depth Asphalt Concrete)

Deep Strength Asphalt Concrete - (See Full Depth Asphalt Concrete)

Department - The Department of Public Works of the City of Stockton. Any reference to the terms "Department" or "Department of Transportation" in Caltrans Standard Specifications shall mean the Department of Public Works of the City of Stockton when referring to the administration of the project.

Director of Public Works - The executive officer of the Department of Public Works as created by law or the executive officer's assigned representative. Any reference to the terms "Director" or "Director of Transportation" in Caltrans Standard Specifications shall mean the Director of Public Works of the City of Stockton. Any reference to the terms "Director" or "Director of Public Works" shall also mean the Director of Municipal Utilities or Director's assigned representative on projects or contracts for which the Municipal Utilities Department is the responsible department.

Electrolier - Street light assembly complete, including foundation, standard, luminaire arm, luminaire, etc.

Engineer - The City Engineer of the City of Stockton acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them. Any reference to the terms "Engineer" or "City Engineer" shall also mean the Director of Municipal Utilities on projects or contracts for which the Municipal Utilities Department is the responsible department.

Engineer's Estimate - The list of estimated quantities of work to be performed as contained in the "Bid Proposal."

Full Depth Asphalt Concrete - The term FULL-DEPTH (registered by The Asphalt Institute with the U.S. Patent Office) certifies that the pavement is one in which asphalt mixtures are employed for all courses above the subgrade or improved subgrade. A FULL-DEPTH asphalt pavement is laid directly on the prepared subgrade. (The mathematical symbol T_a denotes Full-Depth or Total Asphalt.) (May also be referred to as Deep Lift or Deep Strength Asphalt Concrete)

Highway - The whole right-of-way or area which is reserved for and secured for use in constructing the roadway and its appurtenances. Where the work is not specifically highway or street work, the term "highway" or "highway right-of-way" shall be interpreted to mean the property line or the bounded area of the site of the improvement/work or be deleted, where applicable.

Holiday – An undesirable discontinuity or break in the anticorrosion protection on pipe or tubing.

Industrial - Refer to Chapter 16 of the Stockton Municipal Code.

Laboratory - The established laboratory of the City of Stockton and/or the laboratory chosen by, or approved by the City of Stockton and authorized to test materials and work involved in the contract.

Liquidated Damages - The amount prescribed in the special conditions to be paid to the City of Stockton or to be deducted from any payments due or to become due to the Contractor for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the Standard Specifications.

Local (Street Classification) - Roadways used primarily for direct access to residential, commercial, industrial or other abutting property. They do not include roadways carrying through traffic. A local street is defined as a facility having the sole function of providing access to immediately adjacent land.

Clarification questions should be directed to the Traffic Engineering section of the Public Works Department of the City of Stockton.

Lowest Responsible Bidder - The company or firm whose bid is arithmetically lowest and who meets the criteria set forth in Stockton Municipal Code Section 3-025.

Luminaire - The lamp housing including the optical and socket assemblies (and ballast if so specified).

Other Agencies - Whenever reference is made to any Federal, State or County agency or officer, such reference shall be deemed made to any agency or officer succeeding in accordance with law to the powers, duties, jurisdiction, and authority of the agency or officer mentioned.

Plans - (aka Standard Plans and/or Project Plans as applicable) Refer to the definitions under

Standard Specifications and Plans later in this section.

Project Plans - The project plans are specific details and dimensions peculiar to the work and are supplemented by the Standard Plans insofar as the same may apply. The Standard Plans shall also be interpreted to mean those Standard Plans incorporated within the document.

Proposal Guaranty - The cash, cashier's check, certified check, or bidder's bond accompanying the proposal submitted by the bidder, as a guaranty that the bidder will enter into a contract with the City of Stockton for the performance of the work if the contract is awarded to the bidder.

Residential - Refer to Chapter 16 of the Stockton Municipal Code.

Right-of-Way - Any reference to the term "right-of-way" or "highway right-of-way" shall be interpreted to mean the property right-of-way, property line or the bounded area of the side of work, where applicable.

Sand - aka Class 4 aggregate subbase shall conform to the provisions of Sections 19 and 25 of CalTrans standard specifications. Class 4 aggregate subbase material shall be clean and free from vegetable matter and other deleterious substances. The percentage composition by weight of Class 4 aggregate subbase material shall conform to the following grading when determined by test method No. California 202.

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
2 1/2	100%
NO. 200	2 - 35%

Class 4 aggregate subbase material shall also conform to the quality requirements shown in the following table

<u>Tests</u>	<u>Test Method No. Calif.</u>	<u>Requirements</u>
Sand Equivalent	217	20 min.
Resistance	301	55 min.

Service Connection - Service connections are all or any portion of the conduit, cable or duct, including meter, between a utility distribution line and an individual consumer.

Sewer - Any conduit intended for the reception and transfer of sewage and fluid industrial waste.

Sewer (Private) - A sewer, wholly within private property and maintained privately.

Sewer Connection - A sewer, within a public street, a public utility easement right of way, proposed to connect any parcel, lot or part of a lot with a main line sewer.

Specifications - (aka Standard Specifications) The written directions, provisions, and requirements contained in the "Standard Specifications and Plans" as published by the City of Stockton and as supplemented by the Special Provisions.

Special Provisions - The special provisions are specific clauses setting forth conditions or requirements peculiar to the work and supplementary to these Standard Specifications and Plans. The State of California, Department of Transportation publication entitled "Labor Surcharge and Equipment Rental Rates and General Prevailing Wage Rates" are to be considered as a part of the special provisions.

Standard Specifications and Plans - The official Project Plans and Standard Plans, profiles, typical cross sections, general cross sections, working drawings and supplemental drawings, or reproductions thereof signed by the City Engineer, which show the location, character, dimensions and details of the work to be performed. All such documents are to be considered as part of the Standard Plans whether or not reproduced in the special provisions.

In the above definition, the following terms are defined as follows:

- (a) Standard Plans - The Standard Detail Drawings of the Department of Public Works published as part of the Standard Specifications and Plans as may be adopted, or adopted and modified in the project plans.
- (b) Project Plans - The project plans are specific details and dimensions peculiar to the work and are supplemented by the Standard Plans insofar as the same may apply. The Standard Plans shall also be interpreted to mean those Standard Plans incorporated within the document.
- (c) Standard Specifications - The written directions, provisions, and requirements contained in the "Standard Specifications and Plans" as published by the City of Stockton and as supplemented by the Special Provisions.
- (d) Special Provisions - The special provisions are specific clauses setting forth conditions or requirements peculiar to the work and supplementary to these Standard Specifications and Plans. The State of California, Department of Transportation publication entitled "Labor Surcharge and Equipment Rental Rates and General Prevailing Wage Rates" are to be considered as a part of the special provisions.

State - The State of California. Any reference to the terms "State" or "State of California" in Caltrans Standard Specifications with reference to administration of the project, shall mean the City of Stockton, where applicable.

State Treasurer - Shall be interpreted to mean the City of Stockton Finance Department, where applicable.

Storm Drain - (aka Storm Sewer) Any conduit and appurtenances intended for the reception and transfer of storm water.

Storm Water Management Program - The City of Stockton's Storm Water Management Program as delineated in the City's NPDES Permit for Storm Water Discharges from Municipal separate storm sewer systems.

Street - Any road, highway, parkway, freeway, alley, walk, or way.

Subcontractor - The individual, partnership, corporation or other legal entity entering into a contract with the contractor to perform a portion of the work.

Surety - Any individual, firm or corporation, bound with and for the contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Traveled Way - That portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Utility - Tracks, overhead or underground wires, pipe lines, conduits, ducts, or structures, sewers or storm drains owned, operated, or maintained in or across a public right of way or private easement.

Welding Specifications - The directions, provisions and requirements contained in these Standard Specifications as modified and as supplemented by the special provisions. Caltrans "Standard Specifications for Welding Structural Steel" dated January 1981 is to be considered a part of these Standard Specifications. Whenever the term "these specifications" is used in this book, it means the provisions set forth in the City of Stockton Standard Specifications and Plans and Caltrans "Standard Specifications for Welding Structural Steel."

SECTION 2

BIDDING

2-1.06A Bid Documents – General – Replace with the following: The City of Stockton Specifications and Standard Drawings can be viewed and download from the City’s website:

<http://www.stocktongov.com/government/departments/publicWorks/enginStand.html>

The Notice to Bidders and Special Provisions and project plans may be viewed at the City of Stockton Bid Flash website:

<http://www.stocktongov.com/services/business/bidflash/default.html>

The City will furnish to each bidder a standard bid form packet, with instructions which, when properly executed and submitted shall be the bidder's bid. Bids, not presented on forms so furnished, or when the Instructions to Bidder are not followed, shall be considered non-responsive.

Bid forms are furnished with the Special Provisions and Project Plans and can be downloaded from the Bid Flash website shown above.

2-1.12 – 2-1.27 – These sections of Caltrans Specifications are to be deleted. Please refer to the City’s Instructions to Bidders which replaces the deleted information.

2-1.30 Job Site and Document Examination - The following is to be added: Oral interpretations or clarifications of the Standard Plans and Specifications, Special Provisions or other project-related documents shall have no legal or binding effect. Any such requests for interpretation or clarification shall be made in writing and will be answered in writing. If errors are found, the bidder shall provide written notification as soon as possible prior to the bid opening in order that letters of clarification can be prepared and given to all bidders.

Where the City has made investigations of subsurface conditions in areas where work is to be performed under the contract, or in other areas, some of which may constitute possible local material sources, such investigations are made only for the purpose of study and design. Where such investigations have been made, bidders or Contractors may, upon written request, inspect the records of the City as to such investigations subject to and upon the conditions hereinafter set forth.

The records of such investigations are not a part of the contract and are shown solely for the convenience of the bidder or contractor. It is expressly understood and agreed that the City assumes no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations thus made, the records thereof, or of the interpretations set forth therein or made by the City in its use thereof and there is no warranty or guaranty, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas or any part thereof, or that developments, not specifically looked for, may not occur, or that materials other than, or in proportion different from those indicated, may not be encountered.

The availability of information described in this Section is not to be construed in any way as a waiver of the provisions of the second paragraph of this Section and each prospective bidder and Contractor is cautioned to make such independent investigations and examinations as each of them may consider necessary to sufficiently inform itself as to the conditions to be encountered in the performance of the Work, and, with respect to possible local material sources, the quality and quantity of material available from such sources and the type and extent of processing that may be required in order to produce material conforming to the requirements of the contract. No information derived from such inspection of records of investigations or interpretations thereof made by the City or from the City shall in any way relieve any prospective bidder or Contractor from any risk or from properly fulfilling the terms of the contract.

2-1.31 Department of Industrial Relations Registration Requirements (DIR) - Every contractor or subcontractor bidding on a contract for public works must register with the California Department of Industrial Relations. Pursuant to Labor Code Section 1771.1 the DIR contractors will not be determined to be qualified to bid, be listed on bid proposals or perform any contract work unless currently registered and qualified to perform public work. Contractors may register with the DIR for a fee by going to: <http://www.dir.ca.gov/Public-Works/Contractor-Registration.html>

The City will not accept bids from those contractors that are not registered with the DIR.

2-1.32 Certified Payroll Records - Contractors and Subcontractors are required to submit certified electronic payroll records to the California Labor Commissioner.

2-1.33 Bid Document Completion - The following supersede Caltrans Specifications 2-1.33 entirely: Prospective bidders shall obtain the bid form from the City of Stockton website as shown in Section 2-1.06A. The bid form will state the location and description of the contemplated construction and if applicable show the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished, with a schedule of items for which bid prices are asked.

The quantities given in the bid form and contract are approximate only, being given as a basis for the comparison of bids. The City does not expressly or by implication, agree that the actual amount of work will correspond therewith, and reserves the right to increase or decrease the amount of any class or portion of the work, or to omit portions of the work, as may be deemed necessary or advisable by the Engineer.

The bidder shall set forth for each item of work, in clearly legible figures, an item price and a total for the item in the respective spaces provided, and shall be signed by the bidder, who shall fill out all blanks in the bid form as therein required.

All bids shall be clearly and distinctly written and if any erasure or interlineation occurs therein, before the bid is filed with the City Clerk, said erasure or interlineation shall be initialed by the person authorized to prepare and execute the bid.

Each sealed bid shall be marked "BID" and shall indicate the project name, number, and bid opening date, and shall be mailed or delivered to the Office of the City Clerk, City Hall, at the

time and place designated in the notice inviting bids. Bids so received shall be publicly opened, examined, and declared by the City Clerk. A bid received after the specified time shall not be accepted and will be returned to the bidder unopened. A bid that is not properly marked may be rejected at the discretion of the City. Bidders and the public are invited to be present at the declaration of said bids. A contract will be awarded to the lowest responsible bidder as defined in the Stockton Municipal Code; provided, however, that the City Council reserves the right to reject any and all bids and to re-advertise for bids or to provide for the work to be done by the City of Stockton.

2-1.33D Opt out of Payment Adjustments for Price Index Fluctuations - This section of Caltrans Specifications is to be deleted.

2-1.34 Bidder's Security – The following is to supersede Caltrans Specification 2-1.34 entirely: All bids shall be presented under sealed cover and accompanied by one of the following forms of bidder's security:

Cash, a cashier's check, a certified check, or a bidder's bond executed by an admitted surety insurer, made payable to the City of Stockton. The security shall be in an amount equal to 10 percent of the amount of bid. A bid will not be considered unless one of the above described forms of bidder's security is enclosed with it.

If the bidder to whom the contract is awarded shall, for 30 days after receipt of such award, fail or neglect to enter into the contract and file any required performance bond and/or labor and material bond, the bid security shall be forfeited and the City Finance Director shall draw the money due on such bid security and pay the same, or any cash deposited, into the City Treasury. The bid security shall not be returned to the defaulting bidder in such case unless the City Council approves the return in whole or in part.

2-1.35 SSPC QP Certification Preaward Qualification - This section of Caltrans Specifications is to be deleted.

2-1.40 Bid Withdrawal - The following is to supersede Caltrans Specification 2-1.40 entirely: Any bid may be withdrawn at any time prior to the time fixed in the public notice for the opening of bids only by written request for withdrawal of the bid filed with the City Clerk. The request shall be executed by the bidder or the bidder's duly authorized representative. The withdrawal of a bid does not prejudice the right of the bidder to file a new bid. Whether or not bids are opened exactly at the time fixed in the public notice for the opening of bids, a bid will not be received after that time, nor may any bid be withdrawn after the time fixed in the notice for the opening of bids.

2-1.47 Bid Relief - The following is to supersede Caltrans Specification 2-1.47 entirely: If the bidder claims a mistake was made in the bidder's bid, the bidder shall give the City written notice in the manner and time specified in the Public Contract Code of the alleged mistake, specifying in the notice in detail how the mistake occurred.

After review of the mistake claimed by the bidder, the City may waive a minor irregularity that does not give a competitive advantage to another bidder. The City is not obligated to waive

irregularities.

2-1.51 Bid Protests – All parties wishing to file a protest shall comply with the procedures set forth below.

All protests regarding the bidding process or the award, or intended award, of any contract must be submitted in writing to the City Attorney on or before 5:00 p.m. of the fifth business day following the opening of all bids, unless a different time period is specified in the Notice Inviting Bids or other bid solicitation documents. All protests must be addressed to: City Attorney, City of Stockton, 425 North El Dorado Street, 2nd Floor, Stockton, CA 95202. The party filing the protest must have actually submitted a bid for the work. A subcontractor of a bidder may not submit a bid protest.

The protest shall contain a full and complete statement specifying in detail the grounds of the protest and the facts in support thereof. The protest must be hand delivered or sent via mail so that it is received by the City Attorney within the time period set forth above. The protest document must include the following:

- A complete statement of the factual and legal basis for the protest;
- The protest must include the name, address and telephone number of the person representing the protesting party; and
- The protesting party must concurrently transmit a copy of the written protest document and any attached documentation to all other bidders who may have a reasonable prospect of receiving the award depending upon the outcome of the protest.

The procedure and time limits set forth herein are mandatory and the bidder's sole and exclusive remedy in the event of protest. No bidder may bring an action or proceeding challenging the bidding process or any award, or intent to award, any contract unless the above procedures are followed. The failure of a party originating a protest to comply with these procedures shall constitute a waiver of any right to further pursue the protest, including filing a government code claim or legal proceeding. The City reserves the right to modify the bid protest procedures in the Notice Inviting Bids or other bid solicitation documents and to require any protesting party to submit additional or clarifying information or documentation in support of any protest.

SECTION 3

CONTRACT AWARD AND EXECUTION

3-1.04 Contract Award – The following is to supersede Caltrans Specifications 3-1.04 entirely: The City reserved the right to reject any and all proposals. The award of the contract, if it be awarded, will be to the lowest responsible bidder whose proposal complies with all the requirements prescribed. Such award, if made, will be made as stated in the special provisions. If the lowest responsible bidder refuses or fails to execute the contract, the City of Stockton may award the contract to the second lowest responsible bidder.

All bids will be compared on the basis of the Engineer's Estimate of the quantities of work to be done.

3-1.05 Contract Bonds – The following is to supersede Caltrans Specifications 3-1.05 entirely: The Contractor will be required to furnish a surety bond for the faithful performance of the Contractor's contract and also a labor and material bond, each in the sum of one hundred percent (100%) of the contract price.

The Faithful Performance Bond will be retained by the City of Stockton for twelve (12) months following final acceptance by the City of the improvements to guarantee correction of failure attributable to workmanship and materials. Upon said final acceptance by the City, the amount of the Faithful Performance Bond may be reduced to ten percent (10%) of the actual improvement construction costs.

The bonds required of the Contractor shall be furnished by a company authorized to do a surety business in the State of California: said bonds shall be executed by the Surety and Contractor before or concurrently with the signing of the contract. The form of said bonds shall be approved by the City Attorney and the surety of Sureties shall be approved by the Director of Finance.

All alterations, extensions of time, extra or additional work and other changes authorized by these Standard Specifications, or any part of the contract may be made without securing the consent of the Surety on the contract bonds.

3-1.06 Contract License - The following shall be added: In additions to the Contractor's license, the Contractor shall obtain a business license from the City of Stockton.

3-1.07 Insurance Policies - The following is to supersede Caltrans Specifications 3-1.07 entirely: The successful bidder must submit the insurance Policies requirements as identified in the Instruction to Bidders packet.

3-1.08 – 3-1.11 - These sections of Caltrans Specifications are to be deleted.

3-1.18 Execution of the Contract - The following is to supersede Caltrans Specifications 3-1.18 entirely: The contract shall be executed within ten (10) days not including Saturdays and Sundays and legal holidays, after the bidder has received the contract.

Failure of the lowest, the second lowest, or the third lowest to execute the contract and file acceptable bonds as provided herein within 10 days not including Saturdays, Sundays and legal holidays, after the bidder has received the contract, shall be just cause for the forfeiture of the proposal guaranty. The successful bidder may file with the City Clerk a written notice, signed by the bidder or the bidder's authorized representative, specifying that the bidder will refuse to execute the contract if presented to the bidder. The filing of such notice shall have the same force and effect as the failure of the bidder to execute the contract and furnish acceptable bonds within the time herein before prescribed.

3-1.19 Bidder's Securities – The following is to supersede Caltrans Specifications 3-1.19 entirely: Within 10 days after the award of the contract to the lowest and best responsible bidder, the City of Stockton will return the proposal guaranties accompanying the proposals no longer being considered.

The proposal guarantee of the lowest responsible bidder will be held until evidence of insurance, a current City of Stockton business license, and satisfactory bonds are provided and the contract is fully executed and filed with the City Clerk.

SECTION 4

SCOPE OF WORK

4-1.05A Changes and Extra Work - General - The following is to be added: The City reserves the right to make such alterations, deviations, additions to or omissions from the plans and specifications, including the right to increase or decrease the quantity of any item or portion of the work, as may be deemed by the Engineer to be necessary or advisable and to require such extra work as may be determined by the Engineer to be required for the proper completion or construction of the whole work contemplated. Such changes, no matter how many, shall be within the contemplation of this Contract and shall not be the basis for a compensable delay. Any such changes will be set forth in a contract change order which will specify, in addition to the work to be done in connection with the change made, adjustment of contract time, if any, and the basis of compensation for such work. A contract change order will not become effective until approved by the authorized City official and/or the City Council. A reservation of rights, non-waiver of claims, or similar exceptions or reservations by the Contractor on a Change Order for additional time, money, or anything else shall not be permitted and are of no force or effect. It is the intent of the City to have all Change Orders issued comprehensively to address all issues known and unknown relating to time and/or costs.

For contracts approved by the City Council for initial prices of less than One Hundred Thousand Dollars (\$100,000), individual and/or cumulative change orders of Seventy Five Thousand Dollars (\$75,000) or that amount approved by City Council Action or greater require City Council approval. For contracts approved by the City Council with initial prices of One Hundred Thousand Dollars (\$100,000) or more, individual and/or cumulative changes orders which exceed Seventy Five Thousand Dollars (\$75,000) or that amount approve by City Council Action plus ten percent (10%) of the initial contract price over One Hundred Thousand Dollars (\$100,000) require City Council approval.

Change orders not meeting the above criteria require approval by the authorized CITY official executing the contract. The dollar amounts of change orders approved by specific City Council action, plus the dollar amounts of any change orders which predate such specific City Council action, shall be counted in computing the new authority limits set forth above for CITY officials to approve change orders hereunder.

When the compensation for an item of work is subject to adjustment under the provisions of this Section 4-1.05A, the Contractor shall, upon request, promptly furnish the Engineer with adequate detailed cost data for said items of work.

In the opinion of the Engineer, if work cannot reasonably be performed concurrently with other items of work and if a controlling item of work is thereby delayed, an adjustment to the Contract time of completion will be granted in writing upon receipt of a written request from the Contractor and no additional compensation shall be allowed.

In emergency situations, the authorized City official may issue a change order beyond the authority

limits described above in order to:

- (a) Prevent interruption of the work which would result in a substantial increase in the costs to, or liability of the City; or
- (b) Protect the work, equipment, materials to be used in the work, human safety, or the environment at or near the work from substantial and immediate danger or injury; or
- (c) Protect, where damage or injury has occurred, the work, equipment or materials to be used in the work, human safety, or the environment from further or additional damage or injury or deterioration.

The authorized City official shall have the authority to issue change orders in such sums as is reasonably necessary for such emergency purposes. After issuing a change order in an emergency situation described above, the authorized City official shall report such action and the reasons therefor to the City Council in writing not later than its next regularly scheduled meeting or as soon thereafter as is practicable. Upon receipt of an approved contract change order, the Contractor shall proceed with the ordered work. If ordered in writing by way of a field order directive, the Contractor shall proceed with the work so ordered prior to actual receipt of an approved contract change order therefor. In such cases, the Engineer will, as soon as practicable, issue an approved contract change order for such work.

The Contractor shall obtain a field order directive or contract change order from the Engineer **PRIOR** to performing any extra work otherwise the Extra Work will not be compensated.

4-1.06 Differing Site Conditions - During the progress of the work, if subsurface or latent physical conditions, differing materially from those indicated in the Contract, are encountered at the site or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract, are encountered at the site, the party discovering such conditions shall promptly notify the Engineer in writing of the specific differing conditions before they are disturbed and before the affected work is performed. In the event that the differing site conditions are discovered after work has begun, written notice is required within 48 hours after discovery of such conditions.

Upon written notifications, the Engineer will investigate the conditions to determine if the site conditions substantially differ to cause an increase or decrease in the cost or time required for the performance of any work under the Contract. At the discretion of the Engineer, an adjustment may be made and the Contract may be modified in writing accordingly. The Engineer will notify the Contractor of his/her determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice. No Contract adjustment will be allowed under the provisions specified in this section for any effects upon unchanged work.

Any Contract adjustment warranted due to differing site conditions will be made in accordance

with the provisions in Section 4-1.05, "Changes and Extra Work," of the Standard Specifications.

4.1.07 Value Engineering - This section of Caltrans Specifications is to be deleted.

SECTION 5

CONTROL OF WORK

5-1.02 Contract Components - The following supersedes Caltrans Section 5-1.02 in total: A component in one Contract part applies as if appearing in each. The parts are complementary and describe and provide for a complete work.

If a discrepancy exists:

1. The governing ranking of Contract parts in descending order is:
 - 1.1 Contract, including change orders
 - 1.2 Project Special Provisions
 - 1.3 Project Plans
 - 1.4 City's Standard Specifications
 - 1.5 City's Standard Drawings
 - 1.6 Revised Caltrans Standard Specifications
 - 1.7 Caltrans Standard Specifications
 - 1.8 Revised Caltrans Standard Plans
 - 1.9 Caltrans Standard Plans
 - 1.10 Supplemental Project Information
2. Written numbers and notes on a drawing govern over graphics
3. A detail drawing governs over a general drawings
4. A detail specification governs over a general specification
5. A Specification in a section governs over a specification referenced by that section

If a discrepancy is found or confusion arises, submit an RFI.

5-1.02A Plans and Working Drawings - Record drawings of all improvements shall be provided by the Contractor involved in constructing the improvement. Record drawings shall be neatly and accurately done on a set of Project Plans and delivered to the Department of Public Works as a condition precedent to acceptance of the project.

The Engineer shall review working drawings before any work involving these plans is performed.

On private development work, at the conclusion of construction, the Engineer who prepared the improvement plans will add to the Project Plans, for City record purposes, construction data based on information compiled and furnished by the Engineer, contractors, inspector and others.

On those facilities that will be extended in the future (such as sanitary lines, storm drain lines, water lines and curb and gutter installations), the Engineer shall shoot the grades at the end of the facilities and include the "as constructed" grades on the record drawings.

5-1.03 Engineer's Authority - The following is to be added: Unless otherwise stated, the words *directed, required, permitted, ordered, instructed, designated, considered necessary, prescribed,*

reviewed, approved, acceptable, satisfactory, or words of like import, refer to actions, expressions, and prerogatives of the Engineer.

5-1.09 Partnering - This section is expressly deleted and is not applicable to work done for the City of Stockton. This will be applied on a case by case basis and shall be stated in the special provisions.

5-1.12 Assignment - The following is to be added: No contract or portion thereof may be assigned without consent of the City of Stockton except that the contractor may assign money due, or which will accrue to them, under the contract. If given written notice, such assignment will be recognized by the City of Stockton to the extent permitted by law, but any assignment of money shall be subject to all proper setoffs and withholdings in favor of the City of Stockton and to all deductions provided for in the contract. All money withheld, whether assigned or not shall be subject to being used by the City of Stockton for completion of the work, should the contract be in default.

5-1.13A Subcontracting - General - The following is to be added: The Engineer may also determine, on a case by case basis, items to be designated "Specialty Items." Where an entire item is subcontracted, the value of work subcontracted will be based on the contract item bid price.

5-1.13C Disabled Veteran Business Enterprises - This section of Caltrans Specifications is to be deleted.

5-1.13D Non-Small Businesses - This section of Caltrans Specifications is to be deleted

5-1.26 Construction Surveys - The following is to be added: The Engineer will set one bench mark on the job site and at the option of the Contractor will either (1) stake the center line, (2) stake an offset line, or (3) stake a base line with necessary grades as required one time only. It is expected that on small projects the City will provide the field services. On all subdivisions, or on large and complicated projects, the special conditions will set forth the extent of field service to be provided by the City and whether or not a licensed surveyor or civil engineer shall perform all or part of the engineering work. On Public Works contracts, however, engineering layout will be provided by the City of Stockton as noted in Items 1, 2, or 3 above. Where the City of Stockton does provide staking, it shall be preserved carefully by the Contractor and will only be replaced by the City in the case of malicious mischief or vandalism perpetrated by a third party.

The Contractor shall preserve all monumentation potentially affected by the work in accordance with Section 8771 of the Professional Land Surveyors Act in the Business and Professions Code of the State of California. Locations of known existing monumentation within the area of work shall be indicated on the plans. If required, tie-out of existing monuments shall be completed and appropriate documentation submitted to the City Engineer prior to beginning work. Unless otherwise specified, all construction staking or survey work shall be performed by an appropriately licensed land surveyor or civil engineer.

5-1.31 Job Site Appearance - The following is to be added: The Contractor shall conduct and cause all working forces at the site to maintain the site in a neat orderly manner throughout the construction operations. The work shall be conducted in a manner that will control the dust.

When ordered to provide dust control, the Contractor shall use water or turn soil to reduce the dusty conditions, all to the satisfaction of the Engineer and in accordance with Section 10 of the Standard Specifications. During construction, the Contractor shall remove all rubbish and debris as it is generated to the satisfaction of the Engineer.

Contractor's activities shall conform to the requirements of the Storm Water Management Program and/or BMPs delineated in the project SWPPP. All appropriate provisions of the General Permit including Post-Construction Storm Water Management shall be adhered to.

Nothing herein, however, shall require the Contractor to remove warning, regulatory, and guide signs prior to formal acceptance by the City.

Full compensation for all site maintenance and cleanup will be considered as included in the prices paid for the various contract items of work and no separate payment will be made therefor.

5-1.36E Use of Private Property - The following is to be added: Should the Contractor intend to use privately owned property for the storage of any type of material, or equipment, or for vehicle parking or for any other purpose related to the work, the Contractor shall make the necessary arrangements and shall, precedent to such use, provide the Engineer with satisfactory written evidence that the owner of such property has granted permission of such uses. Prior to the final acceptance of the work, the Contractor also shall provide to the Engineer an acceptable written release from such owner indicating that all of the conditions of such agreement are satisfied.

5-1.37B Load Limits - The following is to be added: The Contractor will be permitted to operate unladen vehicles and to haul Portland cement concrete for paving on completed cement treated base, provided that:

- (1) The cement treated base has cured for 7 days;
- (2) Hauling is limited to the lane immediately adjacent to the median in each direction;
- (3) Maximum weight limitations set forth in Division 15 of the Vehicle Code are not exceeded; and
- (4) Block cracking does not occur under hauling operations.

If block cracking occurs, the Engineer may order said loads to be reduced so that the maximum weight upon any one wheel, or wheels, supporting one end of an axle, and resting upon the roadway, will not exceed 9,000 pounds. The Contractor shall not be entitled to any additional compensation nor extension of contract time by reason of such load reduction.

5-1.38 Maintenance and Protection Relief - Delete the entire section in Caltrans and replace it with the following: Upon the request of the Contractor, the Director may relieve the

Contractor of the duty of maintaining and protecting certain portions of the work which have been completed in all respects in accordance with the requirements of the contract and to the satisfaction of the Engineer, and thereafter except with the Contractor's consent, the Contractor will not be required to do further work thereon. In addition, such action by the Director will relieve the Contractor of responsibility for injury or damage to said completed portions of the work resulting from use by public traffic or from the action of the elements or from any other cause but not from injury or damage resulting from the Contractor's own operations or from the Contractor's negligence.

However, nothing in this Section 5-1.38 providing for relief from maintenance and responsibility will be construed as relieving the Contractor of full responsibility for making good defective work or materials found at any time before the formal written acceptance of the entire contract by the Director.

5-1.43E Alternative Dispute Resolution - This section of Caltrans Specifications is to be deleted.

5-1.46 Acceptance of Contract - The following is to be added: When the Engineer has made the final inspection and determines that the contract work has been completed in all respects in accordance with the Standard Specifications and Plans, the Engineer will file a "Notice of Completion" with the County Recorder.

The Contractor hereby unconditionally guarantees that the work will be done in accordance with the requirements of the contract, and further guarantees the work of the contract to be and remain free of defects of workmanship and materials for a period of one (1) year from the date of acceptance of the work as complete, unless a longer guarantee period is specifically required. The Contractor hereby agrees to repair or replace any and all work, together with any other adjacent work which may be displaced in so doing, that may prove to be not in accordance with the requirements of the contract or that may be defective in its workmanship or material within the guarantee period specified, without any expense whatsoever to the City, ordinary wear and tear and unusual abuse or neglect excepted.

Contract bonds are to be in full force and effect during the guarantee period.

The Contractor further agrees, that within ten (10) calendar days after being notified in writing by the Department of Public Works of any work not in accordance with the requirements of the contract or any defects in the work, the Contractor will commence and prosecute with due diligence all work necessary to fulfill the terms of this guarantee, and to complete the work within a reasonable period of time, and in the event the Contractor fails to so comply, the Contractor does hereby authorize the City to proceed to have such work done at the Contractor's expense and the Contractor will pay the cost thereof upon demand.

Notwithstanding the foregoing paragraph, in an event of an emergency constituting an immediate hazard to the health and safety of the City's employees, property or the public at large, the City may undertake at the Contractor's expense without prior notice all work necessary to correct such hazardous condition when it was caused by work of the Contractor not being in accordance with contract requirements.

SECTION 6

CONTROL OF MATERIALS

6-2.03 City Furnished Materials - The following supersedes Caltrans Section 6-2.03 in total: Materials furnished by the City will be available at locations designated in the special provisions or if not designated in the special provisions they will be delivered to the project. Said materials shall be hauled to the site of the work by the Contractor at the Contractor's expense, including any necessary loading and unloading that may be involved. The cost of handling and placing City furnished material shall be considered as included in the price paid for the contract item involving such City-furnished material.

The Contractor will be held responsible for all materials furnished to the Contractor, and he shall pay all demurrage and storage charges. City-furnished materials lost or damaged from any cause whatsoever shall be replaced by the Contractor. The Contractor will be liable to the City for the cost of replacing City-furnished material and such costs may be deducted from any monies due or to become due the Contractor.

6-2.04 Foreign Materials - The following supersedes Caltrans Section 6-20.4 "Local Materials" in total: The Contractor, at no cost to the City, shall supply the facilities and arrange for any testing required in Stockton which the City is not equipped to perform. All testing by the Contractor shall be subject to witnessing by the Engineer.

Where structural materials requiring mill test reports are obtained from foreign manufacturers, such materials shall be furnished only from those foreign manufacturers who have previously established, to the satisfaction of the Engineer, the sufficiency of their in-plant quality controls, as deemed necessary by the Engineer or his representative, to give satisfactory assurance of their ability to furnish material uniformly and consistently in conformance with these Standard Specifications. At the option of the Engineer, such sufficiency shall be established either by submission of detailed written proof thereof or through in-plant inspection by the Engineer or the Engineer's representative or such testing, by a local laboratory certified to be capable to perform the testing, as is determined to be necessary by the Engineer.

6-3.01 Quality - General – The following is to be added: Materials shall be stored in such a manner to reduce their potential to pollute storm water runoff from the site. Storage practices and storm water management from the storage area shall conform to the BMPs in the SWPPP and the requirements of the General Permit.

SECTION 7

LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

7-1.02 Laws– The following is to be added: The Contractor shall observe and comply with all requirements of the Storm Water Management Program, and the General Permit.

7-1.02K(2) Prevailing Wage – The following is to supersede Caltrans Specifications 7-1.02K(2) entirely: Attention is directed to the requirements in the City's "Instructions to Bidder". The general prevailing wage rates for each craft, classification or type of workman are on file at the City Public Works Department. A copy of said wage rates shall be posted by the Contractor in a prominent place at the site of the work.

7-1.02K6 Occupational Safety and Health Standards - The following shall be added: In all operations connected with the work herein specified, the Contractor shall observe the provisions of the Worker's Compensation and Safety Laws of the State of California, Division IV and V of the Labor Code, and shall use all of the accepted and best safety practices for the public and/or the Contractor's employees.

7-1.02K(6)(b) Excavation Safety - The following shall be added: Excavation for any trench 5 feet in depth or more shall not begin until the Contractor has obtained a permit per State of California Construction Safety Orders Section 1539 and Chapter 3.2 Article 2, Section 341 of the California Occupational Safety and Health Regulations (Cal/OSHA). For information regarding this provision Contractor is directed to contact Cal/OSHA in Modesto. A copy of this permit shall be available at the construction site at all times.

The Contractor shall furnish all labor, equipment and materials required to design, construct and remove all shoring, sheeting, lagging, cribbing, piling, or types of support for the walls of the project.

In making excavations for any project, the Contractor shall be fully responsible for providing and installing adequate sheeting, shoring and bracing as may be necessary as a precaution against slides or cave-ins and to fully protect all existing improvements of any kind from damage.

The Contractor shall obtain a permit from the Division of Industrial Safety (Cal-OSHA) and shall submit a copy of the approved permit to the City Engineer prior to the start of excavation. The cost of the permit shall be included in the total bid cost. Nothing in this section shall be construed to impose tort liability on the awarding body or any of its employees.

The criteria given by the California Department of Industrial Relations are MINIMAL. In addition to shoring any excavation, it shall be the Contractor's responsibility to provide any and all additional shoring required to support the sides of the excavation against the effects of loads which may

exceed those derived by using the criteria set forth by said governing agency. The Contractor shall be solely responsible for any damages which may result from the Contractor's failure to provide adequate shoring to support the excavations under any or all of the conditions of loading which may exist or which may arise during construction.

Full compensation for performing the work described above shall be considered as included price paid for the various contract items of work and no additional compensation will be allowed therefor.

7-1.020 Vehicle Code - The following sections of the California State Vehicle Code shall be added: The lighting requirements in Section 25803; the brake requirements in Division 12, the following sections of the State of California Vehicle Code; the splash apron requirements in Section 27600; and, when operated on completed or existing treated base, surfacing, pavement or structures, except as otherwise provided in Section 5-1.37B, "Load Limits," the weight limitation requirements contained in Division 15. Any other requirements which the City will require compliance with, will be set forth in the special provisions.

7-1.03 Public Convenience - The following is to be added: Adequate ingress and egress shall be maintained for fire, police and other emergency vehicles. Adequate ingress and egress shall be maintained at all times for residents, property owners, and business owners. The Contractor may be required to cover certain signs which regulate or direct public traffic to roadways that are not open to traffic.

In the event of a suspension of the work, attention is directed to Section 8-1.06, "Suspensions."

7-1.04 Public Safety - The flagmen shall perform their duties, and the work of furnishing and placing such signs, lights, flags, and other warning and safety devices shall all be performed as set forth in the current "Work Area Traffic Control Handbook" as published by Building News, Inc., Los Angeles, California (310-202-7775, 8:30 AM.-5 PM, M-F).

All safety devices and their maintenance shall conform to the latest requirements of Cal-OSHA and to the applicable provisions of the "Work Area Traffic Control Handbook."

7-1.05 Indemnification - The following is to be added: References in Section 7-1.05 to the "State" shall mean the City of Stockton, its Mayor, Council, officials, representatives, agents, employees, and volunteers. The duty of the Contractor to indemnify and save harmless, as set forth herein, shall include the duty to defend, as set forth in Section 2778 of the California Civil Code provided, however, that nothing herein shall be construed to require the Contractor to indemnify the City against any responsibility or liability in contravention of Section 2782 of the California Civil Code. Contractor's indemnification obligations stated herein are in addition to, and shall not reduce or lessen, the contractor's indemnification obligations set forth in the contract, Instructions to Bidder, or other project-related documents.

7-1.06 Insurance - The insurance provisions stated herein are in addition to, and shall not reduce or lessen, the insurance provisions, and Contractor’s obligations thereunder, set forth in the contract, Instructions to Bidder, or other project-related documents. The following is to be added: The Contractor shall, during the life of the contract, take out and maintain insurance coverage with an insurance carrier authorized to transact business in the State of California as will protect the Contractor or any subcontractor or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, from claims for damages because of bodily injury, sickness, disease, or death of the Contractor's employees or any person other than the Contractor's employees, or for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom. Contractor shall be aware that the maintenance of proper insurance coverage is a material element of a contract with the City and that failure to maintain or renew coverage or to provide evidence of renewal may be treated as a material breach of contract.

The minimum limits of liability for such insurance coverage which shall include commercial general and automobile liability, including contractual liability assumed under the contract, shall be as follows:

1. Limit of Liability for Injury or Accidental Death:

One Person	\$1,000,000
One Accident or Occurrence	\$1,000,000
Aggregate	\$2,000,000

2. Limit of Liability for Property Damage:

Per Occurrence	\$1,000,000
Aggregate	\$2,000,000

Such liability insurance policies shall name the City, its Mayor, Council, officials, employees, agents, and volunteers as additional insureds (“Additional Insureds”) by separate endorsement and shall agree to defend and indemnify the City against loss arising from operations performed under the contract and before permitting any subcontractors to perform work under the contract, the Contractor shall require subcontractors to furnish satisfactory proof that insurance has been taken out and is maintained similar to that provided by the Contractor as it may be applied to the subcontractor's work.

The Contractor shall, during the life of the contract, effect and maintain standard form builder's risk property insurance coverage with an insurance carrier authorized to business in the State of California, which shall include extended coverage, malicious mischief, vandalism, and windstorm coverage, and such coverage shall be applicable to those portions of the work that are subject, but not limited to, fire, theft, and vandalism. Coverage shall be the amount of one hundred percent (100%) of the insured value thereof, including surplus materials and supplies incident to the work, and such scaffoldings, stagings, towers, forms and equipment as are not owned or rented by the Contractor, the cost of which is included in the cost of the work but shall not cover any tools owned by mechanics, any tools, equipment, scaffolding, staging, towers, and forms owned or rented by

the Contractor, the capital value of which is not included in the cost of the work. The City shall be named as loss payee with the Contractor in such builder's risk property insurance policies and they shall be open to City's inspection upon City's request. The foregoing Builders Risk Insurance will not be required on work being performed exclusively on public street right-of-ways or utility easements.

The City and the Contractor waive all rights against each other for damages caused by fire or other perils to the extent covered by insurance under such builder's risk property policies, except such rights as they may have to the proceeds of such insurance coverage and the Contractor shall require similar waivers by subcontractors.

If the Contractor fails to effect and maintain the required builder's risk property insurance coverage, the City may insure its own interest. The City may deduct the cost of taking out, effecting and maintaining such liability and/or builder's risk property insurance coverages from any sums which may be due, or become due, to the Contractor, under the contract.

Evidence of both liability and builder's risk property insurance coverages shall be furnished to the City with form of certificates with endorsements prior to the commencement of the work and said certificates with endorsements shall contain a provision that the coverage or coverages thereunder will not be canceled until at least thirty (30) days prior written notice has been given to the City.

7-1.06C(6) Worker's Compensation - The following is to be added: Pursuant to the requirements of Section 1860 of the Labor Code, the Contractor will be required to secure the payment of Worker's Compensation to the employees in accordance with the provisions of Section 3700 of the Labor Code.

The successful bidder previous to the entering of the contract to do the said work shall take out and maintain in full force and effect worker's compensation insurance with an insurance carrier authorized to transact business in the State of California, covering the bidder's full liability for compensation to any persons employed who may be injured in the carrying out of said contract or the dependents thereof. Evidence of such worker's compensation insurance shall be furnished to the City of Stockton by certificates in duplicate prior to the commencement of the work and said certificate shall contain a provision that the coverage thereunder will not be canceled until at least thirty (30) days prior written notice has been given to the City.

7-1.07 Legal Actions Against the City – In the event litigation is brought against the City concerning compliance by the City with State or Federal laws, rules, or regulations applicable to highway/road work, the provisions of Caltrans Section 7-1.07 shall apply.

SECTION 8

PROSECUTION AND PROGRESS

8-1.04B Standard Start - The following includes changes and/or additions: The Contractor shall begin work after the contract has been approved by the City Council and within ten (10) days after being given notice to proceed or otherwise as may be stated in the Special Provisions. Once started the Contractor shall diligently prosecute the same to completion within the time limit provided in the special provisions.

The Contractor shall arrange a pre-construction conference with the Public Works Department. Notice shall be given to the Public Works Department at least 72 hours in advance of the Contractor's intent to have a pre-construction conference. No work may be performed prior to a pre-construction conference.

8-1.05 Time – The following includes and/or additions: A working day is defined as any day, except Saturdays, Sundays, and City of Stockton legal holidays and days on which the Contractor is specifically required by the special provisions to suspend construction operations, and except days on which the Contractor is prevented by inclement weather or conditions resulting immediately therefrom adverse to the current controlling operation or operations, as determined by the Engineer, from proceeding with at least 75 percent of the normal labor and equipment force engaged on such operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations.

Should the Contractor choose to work on a Saturday, Sunday, or on a holiday recognized by the Labor Unions and/or the City, the Contractor shall reimburse the City of Stockton the actual cost of engineering, surveying, inspection, superintendence, and/or other overhead expenses which are directly chargeable to the contract. Should such work be undertaken at the request of the City, reimbursement will not be required.

8-1.07 Delay - The following is to be added: The Contractor will be required to cooperate with the utilities and others during the rearrangement of utility and other improvements or street facilities, and any delay caused by the rearrangement will not be considered as right of way delays.

8-1.10 Liquidated Damages – The following is to be added: It is agreed by the parties to the Contract that time is of the essence in the completion of this Work, and that in case all the Work called for under the Contract is not completed before or upon the expiration of the time limit as set forth in these Contract Documents, as modified by extensions of time granted by the City, damage will be sustained by the City. As it is impracticable to determine the actual delay damage, it is, therefore, agreed that the Contractor shall pay liquidated damages to the City in the amount set forth below or in the Special Provisions or Contract, per day for each and every day's delay beyond the time prescribed to complete the Work. The Contractor agrees to pay such liquidated damages and in case the same are not paid, agrees that the City may deduct the amount thereof from any monies due or that may become due the Contractor under the Contract.

SECTION 9

MEASUREMENT AND PAYMENT

9-1.00 Lump Sum Contracts - When required by the Special Provisions or requested by the Engineer, the Contractor shall submit to the Engineer within 15 days after award of contract, a detailed schedule of values, to be used only as a basis for determining progress payments on a lump sum contract or any designated lump sum bid item. This schedule shall equal, in total, the lump sum bid and be in such form and sufficiently detailed as to satisfy the Engineer that it correctly represents a reasonable apportionment of the lump sum.

9-1.045 Determination of Rights - The following includes changes and/or additions: If the total monetary amount of all the Contractor's claims arising under or by virtue of the contract does not exceed \$25,000, such claims are subject to determination of rights under the contract by a hearing officer of the City Council of the City of Stockton.

The party seeking a determination of rights shall give notice in writing of the claim to the other party and to the City Council of the City of Stockton, setting forth therein the facts on which the claim is based. Such notice shall be given not later than 6 months after the issuance of the final estimate.

The City Council of the City of Stockton will appoint a hearing officer to hear such claim within 60 days after such notice but not before completion of the contract unless the City consents to earlier appointment. The hearing officer will hear and determine the controversy and render the hearing officer's decision in writing within 60 days after the hearing officer's appointment unless otherwise agreed to by the parties or unless for good cause the hearing officer extends such time. Each party shall bear its own costs and shall pay 1/2 of the cost of the hearing.

Rules and regulations adopted by the City Council of the City of Stockton pursuant to Section 14380 of the Government Code will govern the conduct of the hearings, including requirements as to pleadings and other documents to be filed. The rules and regulations may be obtained from the City Council of the City of Stockton.

Compliance with the notice requirements of this section does not relieve the Contractor of responsibility for complying with any notice or protest requirements specified in these Standard Specifications (e.g., Sections 4-1.05, "Changes and Extra Work," 8-1.10, "Liquidated Damages, and sections 5-1.43A and 5-1.43D " Potential Claim and Dispute Resolution") nor does compliance with the notice requirements of this section relieve the Contractor of responsibility for complying with the claims submission requirements in Section 9-1.17D, "Final Payment and Claims."

The notices required by this section shall be sent as follows: (a) to the City Council of the City of Stockton, 425 N. El Dorado Street, Stockton, California 95202; (b) to the Department; (c) to the Contractor: such notices will be sent to the business address set forth in the proposal.

If the address to which the notice to the City Council of the City of Stockton or to the Department is to be changed, the Department will notify the Contractor in writing of such change. The Contractor may change the address to which such notices are to be sent to the Contractor by giving the Department written notification of such change of address.

9-1.06 Changed Quantity Payment Adjustments - Delete all of Section 9-1.06 from Caltrans Specifications and replace it with the following: All statement or implications of approval of a Contract change order requires City Manager and/or City Council approval. The City, at its sole discretion, may increase or decrease the quantities of the items of work to be completed. In such an event, compensation for all work completed shall be paid at the contract unit price bid regardless of the final quantity of work actually completed.

Any such changes will be set forth in a contract change order, which will specify, in addition to the work to be done in connection with the change made, adjustment of contract time, if any, and the basis of compensation for such work.

9-1.06A Eliminated Items - The City reserves the right to eliminate any contract item of work prior to the award of the contract without incurring any obligation to pay therefor. Should any contract item of the work be eliminated in its entirety following the award of the contract and in the absence of an executed contract change order covering such elimination, payment will be made to the Contractor for actual costs incurred in connection with such eliminated contract item if incurred prior to the date of notification in writing by the Engineer of such elimination.

9-1.07 Payment Adjustments For Price Index Fluctuations - This section in Caltrans specifications is to be deleted and is not applicable to projects with the City of Stockton, unless specified otherwise.

9-1.11 Time Related Overhead - This section in Caltrans specifications is to be deleted and is not applicable to projects with the City of Stockton, unless specified otherwise.

9-1.16A Progress Payment - General – The following is to be amended:
Delete “3. Amount for material on hand” on Caltrans Specifications unless specified otherwise.
Add “5% Retention” to the list.

9-1.16C Materials on Hand - This section in Caltrans Specifications is to be deleted and is not applicable to projects with the City of Stockton, unless specified otherwise.

9-1.16F Retentions - The following supersedes Caltrans Section 9-1.16F in total: The retention proceeds withheld from any payment by a public entity from the original contractor, by the original contractor from any subcontractor, and by a subcontractor from any subcontractor thereunder shall not exceed 5 percent of the payment and in no event shall the total retention proceeds withheld exceed 5 percent of the contract price, all subject to Public Contract Code 7201.

The 5% retention withheld will remain with the City until 35 days after the date of recordation of the Notice of Completion.

9-1.17D Final Payment and Claims - Delete all of Section 9-1.17D from Caltrans Specifications and replace it with the following:

After the work is completed, the Engineer will provide a proposed balancing change order, in writing, stating the total amount payable to the Contractor, including therein an itemization of said amount, segregated as to contract item quantities, extra work and any other basis for payment, and shall also show therein all dedications made or to be made for prior payments and amounts to be kept or retained under the provisions of the contract. All prior estimates and payments shall be subject to correction in the proposed balancing change order. The Contractor shall check the balancing change order and submit a written statement of all claims the Contractor has arising under or by virtue of the contract. No claim will be considered that was not included in which a notice or protest is required under the provision in Section 5-1.43 "Potential Claims and Dispute Resolution", unless the Contractor has complied with the notice or protest requirements in said section. On the Contractor's approval, or if the Contractor files no claim prior to signing the balancing change order, the following will take place:

1. The balancing change order, when signed by the Contractor, indicates that the Contractor agrees to the quantities contained therein as final quantities and the City of Stockton is then to pay up to 95% of the entire contract.
2. At this time, the City will file the Notice of Completion, which constitutes the City's acceptance of the work.
3. Sixty (60) days after the date the Notice of Completion is recorded, the 5% Retention will be released and constitutes the final payment for the work.

If the Contractor files claims prior to signing the balancing change order, the City will revise the balancing change order accordingly if the claims are approved. Such balancing change order and payment shall be conclusive and binding against both parties to the contract on all questions relating to the amount of work done and the compensation payable therefor except as otherwise provided in Sections 5-1.27 "Records," and 9-1.21 "Clerical Errors."

The claims filed by the Contractor shall be in sufficient detail to enable the Engineer to ascertain the basis and amount of said claims. The Engineer will consider and determine the Contractor's claims and it will be the responsibility of the Contractor to furnish within a reasonable time such further information and details as may be required by the Engineer to determine the facts or contentions involved in the Contractor's claims. Failure to submit such information and details will be sufficient cause for denying the claims.

The Director of Public Works will make the final determination of any claims, which remain in dispute after review by the Engineer administering the contract. A board or person designated by said Director will review such claims and make a written recommendation thereon. The Contractor may meet with the Review Board or their staff to make a presentation in support of such claims.

Upon final determination of the claims, the Engineer shall then make and issue the Engineer's final balancing change order in writing and within 30 days thereafter the City will pay the entire sum, if

any, found due thereon. Such final balancing change order shall be conclusive and binding against both parties to the contract on all questions relating to the amount of work done and the compensation payable therefor, except as otherwise provided in Sections 5-1.27 "Records," and 9-1.21 "Clerical Errors."

SECTION 12

TEMPORARY TRAFFIC CONTROL

12-1.01 Temporary Traffic Control - General - The following is to be added: Whenever work is performed within the right-of-way of any roadway classified as an "Arterial" or "Collector" type roadway, as defined in these Standard Specifications, a detailed detour plan shall be required.

Clarification questions should be directed to the Traffic Engineering Section of the Public Works Department of the City of Stockton. The plan shall be designed and signed by an engineer registered with the State of California as a Professional Civil or Traffic Engineer. This detour plan shall be submitted to the Public Works Department for approval a minimum of 10 working days before the beginning of any roadwork. The cost of implementing and maintaining the detour plan shall be borne by the Contractor, utility company, or developer.

12-1.03 Flagging Cost - The following supersedes Caltrans Section 12-1.03 in total: The costs to furnish flaggers, including transporting flaggers, to provide passage of public traffic through the work will be the sole responsibility of the Contractor and no separate payment will be made therefor.

12-1.04 Lane Closure - Whenever a lane closure is made, the Contractor shall close the lane by placing fluorescent traffic cones, portable delineator, or other devices reviewed by the Engineer, along a taper and along the edge of the closed lane adjacent to public traffic. One telescoping flag tree with flags shall be placed at the beginning and at the end of the taper.

Fluorescent traffic cones shall be of good commercial quality, flexible material suitable for the purpose intended. The outer section of the portion above the base of the cone shall be at least 28 inches. The base shall be of sufficient weight and size or shall be anchored in a manner such that the traffic cone will remain in an upright position.

Portable delineators shall conform to the provisions in Section 12-3.04, "Portable Delineators." If the traffic cones or portable delineators are damaged, displaced or are not in an upright position from any cause, said cones or portable delineators shall immediately be replaced or restored to their original location, in an upright position, by the Contractor.

Telescoping flag trees shall be of good commercial quality material, suitable for the purpose intended and shall be capable of maintaining an upright position at all times while in use.

The fluorescent traffic cones or portable delineators shall be placed at intervals as directed by the Engineer, but not to exceed 50 feet.

If the work requires that fluorescent traffic cones or portable delineators be placed in the lane open to public traffic, said cones or portable delineators shall be placed on a 1-1/2 foot width of the lane open to traffic along the side adjacent to the lane to be closed.

Traffic cones or portable delineators, telescoping flag trees with flags, and signs shall be placed before beginning work each day and shall be removed from the site of the work at the end of each working day.

The contractor shall specify the time limits of lane closure upon approval by the City Engineer.

The provisions for lane closure in this Section 12-1.04 will nowise relieve the Contractor from the Contractor's responsibility to provide such devices or measures as may be necessary to comply with Section 7-1.04, "Public Safety."

12-3.04A Portable Delineators - General - The following is to be added: Portable delineators shall be furnished, placed and maintained in accordance with the provisions in Section 7-1.03, "Public convenience," and 7-1.04, "Public Safety," and as provided in the special provisions.

If the portable delineators are damaged, displaced or are not in an upright position, from any cause, said delineators shall immediately be replaced or restored to their original location, in an upright position, by the Contractor.

Only one type of portable delineator shall be used on the project. The type of portable delineator proposed for use on the project shall be submitted to the Engineer for approval prior to placement on the project.

When work is in progress in a trench or other excavation adjacent to the traveled way, the portable delineators shall be placed on the edge of pavement. At other times, the portable delineators shall be placed off of and adjacent to the edge of pavement.

The portable delineators shall be spaced as necessary for proper delineation as directed by the Engineer but not to exceed 50 feet.

The requirements in this Section 12-3.04A will in no way relieve the Contractor from the Contractor's responsibility to provide such devices or measures as may be necessary to comply with the provisions in Section 7-1.04, "Public Safety."

When no longer required for delineation, the portable delineators shall be removed from the site of the work.

SECTION 16

CLEARING AND GRUBBING

16-1.03B Clearing - The following is added:

Where roots of existing trees are to be pruned, the following specification shall be followed:

All roots pruned shall be cut as smooth as possible with the least amount of surface wood exposed or at a 90 degree angle to the root end cut.

All root cuts made over one (1) inch in diameter shall be painted to seal with an approved type of tree seal paint.

SECTION 17

NON-POTABLE WATER SYSTEMS

Specifications and Plans for non-potable water systems shall be prepared in accordance with the Municipal Utilities Department's Non-Potable Water System Guidelines, and as approved by the Municipal Utilities Department.

SECTION 19

EARTHWORK

19-1.01 General - The following is to be added: Lime stabilization may be acceptable as part of roadway structural section design, subject to approval by the Engineer. If approved, Lime Stabilization shall be in conformance with SECTION 24-2: LIME STABILIZED SOIL

19-3.03I Controlled Density Fill – The following supersedes Caltrans Section 19-3.03I in total: CDF will be accepted in lieu of the standard backfill specifications. It shall be mandatory in all situations where the prevention of subsequent settlement after placement of backfill is required and in trenches eight (8) inches wide or less.

19-3.03I(1) Strength Requirements - Non-structural controlled density fill that can be excavated by hand shall produce unconfined compressive 28-day strengths from 50 psi to a maximum of 200 psi. Controlled density fill that is to be excavated by hand shall contain aggregate no larger than 3/8" top size nor shall the 3/8" aggregate comprise more than 30% of the total aggregate content.

Structural controlled density fill shall produce unconfined compressive 28 day strengths from 200 - 1,200 psi, as determined by the project requirements. Coarse aggregate top size and coarse to fine aggregate ratios and contents shall be determined by the clearances surrounding embedded members and the workability requirements.

19-3.03I(2) Materials - Cement shall meet the standards as set forth in ASTM C-150, Type II Cement.

Fly ash shall meet the standards as set forth in ASTM C-618, for Class F pozzolans. The fly ash shall not inhibit the entrapment of air.

Air entraining agent shall meet the standards as set forth in ASTM C-260.

Aggregates need not meet the standards as set forth in ASTM C-33. Any aggregate, producing performance characteristics of the CDF, for any project will be accepted for consideration as follows. The amount of material passing a #200 sieve shall not exceed 12% and no plastic fines shall be present.

19-3.03I(3) Mix Proportions - CDF shall be a mixture of cement, Class F pozzolan, sometimes coarse aggregate, air entraining agent and water. CDF shall be batched by a ready mixed concrete plant and delivered to the job site by means of transit mixing trucks.

The actual mix proportions shall be determined by the producer of the controlled density fill to meet job site conditions, minimum and maximum strengths and unit weight. Entrained air content shall be established for each job with the materials and aggregates to be used to meet the placing and unit weight requirements. Entrained air content may be as high as 20% for fluidity

requirements.

19-3.03I(4) Placement - CDF shall be discharged from the mixer by any reasonable means into the area to be filled. CDF shall be brought uniformly to the elevation as shown on the Standard Plans. Trench sections to be filled with CDF shall be contained at either end by bulkheads of earth fill.

All CDF is to be protected (plated) from traffic loading for at least 72 hours. Exception 4-inch wide trenches need not be plated but may not be paved for 72 hours. All CDF is to be protected from freezing for at least 72 hours after placement and may not be placed at temperatures less than 40F. Nonstructural CDF is to be used for installations that may require future maintenance.

19-3.03I(5) Mix Design - Mix design shall be reviewed and approved by the Engineer.

Structural (200-1200 psi) (current spec 150-1200 psi)

With Aggregate

100 lbs Cement
450 lbs Fly Ash
342 lbs (41 gal) Water
1800 lbs Sand
815 lbs Pea Gravel

Without Aggregate (4-inch wide trenches)

100 lbs Cement
450 lbs Fly Ash
342 lbs (41 gal) Water
2625 lbs Sand

Nonstructural (50-200 psi) (current spec 50-150 psi)

With Aggregate

50 lbs Cement
400 lbs Fly Ash
342 lbs (41 gal) Water
1900 lbs Sand
815 lbs Pea Gravel

Without Aggregate (4-inch wide trenches)

50 lbs Cement
400 lbs Fly Ash
342 lbs (41 gal) Water
2725 lbs Sand

Note: Sand and pea gravel weights are dry weights. For all mixes, slump is greater than 8-inches. These are known to be loose, self-consolidating product / process. If for some reason a lower

slump (stiffer mixture) is desired, the mix design and work process must be submitted for approval.

The engineer will select the appropriate mix design for the application at the site. The typical mix designs may be modified to suit local conditions and materials.

19-5.03B Relative Compaction (95 Percent) - The following supersedes Caltrans Section 19-5.03B in total:

A Relative Compaction of not less than 95 percent shall be obtained for a minimum depth of 6 inches (0.5 foot) below the grading plane for the full width of any street and trench section.

19-5.03C Relative Compaction (90 Percent) - The following supersedes Caltrans Section 19-5.03C in total:

A Relative Compaction of not less than 90 percent shall be obtained in all material except as specified herein to be 95 percent or as may be otherwise specified in the Special Provisions, contract plans, or in the City of Stockton Standard Specifications and Plans.

SECTION 24-2

LIME STABILIZED SOIL

24-2.01A Summary– Add the following: The use of lime stabilization shall be subject to submittal of a mix design prepared by a Contractor-provided licensed geotechnical engineer and approval of same by the Engineer. The approved mix design shall be based on the actual soils to be used and shall specify the type and amount of lime and the type and amount of curing seal to be applied.

The maximum allowable R-value attributable to lime-stabilized soil for purposes of roadway structural design shall be 50.

The maximum allowable design compressive strength attributable to lime-stabilized soil shall be 200 psi.

The gravel equivalency factor for lime-stabilized soil shall be 1.1.

The in-place moisture content of the soil immediately below the lime-stabilized layer shall be maintained above the optimum moisture content, as determined by California Test 373, prior to application of the lime.

A minimum of 4” of aggregate base shall be installed between lime-stabilized soil and asphalt concrete paving unless otherwise approved by the Engineer.

The preparation, spreading, mixing, compaction, rolling, grading and curing of lime-stabilized soil shall be completed under the observation of a Contractor-provided licensed geotechnical engineer who shall submit a Certificate of Compliance for the lime-stabilized soil prior to acceptance by the City.

24-2.03C Applying Lime - Add the following: The area to be stabilized by lime treatment shall extend a minimum of two feet beyond the edge of pavement.

24-2.03D Mixing - Add the following: The minimum depth of lime-stabilized soil shall be 12 inches. An additional three inches of lime-stabilized soil shall be added to all roadway structural design sections as a safety factor.

SECTION 39

HOT MIX ASPHALT

39-1.41 Full Depth Asphalt Concrete – Where a Full Depth section is specified, it shall be placed on a previously prepared subgrade as specified in 19-5.03B (Relative Compaction) to a tolerance of 0.05 foot above or below the subgrade established by the Engineer.

In placement and compaction shall conform to Section 39-3 “Method Construction Process” of Caltrans Specifications. The final grade of the lift below the surfacing course shall not vary more than 0.05 foot above or below the planned grade for that course.

The thickness of the surface course shall be as specified in the project Special Provisions, all other asphalt concrete below this point is considered base course.

Tack coat (paint binder) shall be SS-1h or CSS-1h type emulsion conforming to Caltrans Specifications Section 94 of the Standard Specifications. Tacking between base courses required at the rate of 0.02 to 0.10 gallons per square yard of the surfaced covered. The exact rate will be determined by the Engineer. Application in excess of 0.02 gallon per square yard will be at Contractor's expense.

Where Full Depth sections are placed in existing streets with established gutter sections, a continuous wedge shape section of asphalt paving shall be placed against the gutter edge, held below the gutter lip by the amount of the thickness of the surface course and feathered to subgrade in a width of not less than three feet before placement of the level courses, unless otherwise permitted by the Engineer.

Upon completion of all portions of the construction, including utility grade adjustments to finish grade, the surface course shall be placed, gutter lip to gutter lip, for the entire length of the project to provide a smooth uniform riding surface with a minimum of transverse joints for the entire project.

Paving shall feather smoothly into existing pavement. Side street construction shall have a section varying from a uniform cross-slope at ends of curb return to variable or parabolic section as required to match the existing street section. Transition shall be smooth and uniform between the points described above.

39-1.42 Material – Hot Mix Asphalt (HMA) shall conform to the provisions of Section 39 of the Caltrans Standard Specification. HMA must be Type A or Type B. Unless otherwise specified, asphalt concrete shall be Type B. Asphalt binder must be PG 64-10 or PG 70-10 and must comply with section 39-1.02D of Caltrans Standard Specifications.

For surface course and base course paving on low or medium local streets, asphalt concrete shall be Type B, ½" nominal maximum aggregate size.

Unless otherwise specified or approved by the Engineer, HMA for base and surface course paving for all other streets shall be Type A, ¾" maximum, medium aggregate.

For non-City projects, the precise asphalt binder content shall be in accordance with a mix design pre-approved by the City Engineer within twelve months of placement of the asphalt concrete. For City projects, the asphalt oil content shall be as specified in the project specification special provisions. An HMA Mix designs shall conform to Caltrans Specifications section 39-1.03 "Hot Mix Asphalt Mix Design Requirements" and must be submitted.

39-1.43 Spreading and Compaction – Unless specified in the project Special Provisions, spreading and compaction must be in accordance to section 39-3 "Method Construction Process". The maximum compacted thickness of any one base course of asphalt concrete shall be three (3) inches. The maximum compacted thickness of the surface course (1/2" aggregate) of asphalt concrete shall be two (2.0) inches, and the minimum thickness shall be one (1) inch after compaction.

A mechanical paving machine shall only be required for spreading the surface course and any leveling courses required.

HMA base courses may be spread and compacted by such mechanical means as will provide a surfacing of uniform smoothness and texture in such a manner as to prevent segregation of materials. Approval will be based on demonstrated performance of such equipment.

A prime coat of SC250 or MC250 shall be applied to all aggregate bases to be surfaced. The prime coat shall be applied at a rate of 0.2 gallon per square yard over the entire roadway area to be surfaced.

Rolling of Full Depth base courses shall be from the center of the paving pass to the edge.

The Contractor shall furnish a minimum of one (1) steel wheel tandem roller with a gross static weight of at least 7.5 tons and one (1) 15-ton pneumatic tired roller. At the Engineer's discretion, a third steel 2 axle roller of a minimum weight of 7.5 tons may be required.

Alternate compacting equipment or substitution of a vibratory roller for a pneumatic-tired roller will not be permitted, approved or reviewed.

Tire pressure of the pneumatic tire roller at the time of breakdown rolling shall be 60 psi minimum and maintained such that the air pressure does not vary more than 5 psi. It is suggested that the pneumatic tire roller have twenty (20) inch rims to help prevent bogging down. The pneumatic tire roller shall be used to break down the spread of asphalt concrete bases and shall operate immediately behind the paver or spreader.

Roller tires shall be preheated and operated hot and dry or have proper spray equipment for use of Roller-Ease to prevent pick up of hot mix.

All courses shall be compacted with a pneumatic roller. In truck routes, each course shall be pneumatic and steel rolled. Rolling shall continue until ruts are eliminated and the proper degree of compaction is achieved. Final rolling of the surface course shall be accomplished with a steel wheel tandem roller, vibrator turned off, at the minimum temperature specified in section 39-3.04 of Caltrans Standard Specifications.

The surface of the completed base course at any point shall not vary more than 0.02 feet above or below the grade established for surface course placement.

The Contractor will be responsible for construction grades. The City will set a base line and furnish cuts for gutter flowlines and pavement centerline or edge of pavement grade. Base course surface prior to placement of surface course which does not meet the above requirements shall be planed or filled at the contractor's expense in a manner acceptable to the Engineer that will not damage the existing compacted base and will obtain the required material compaction at required temperature.

SECTION 71

SANITARY SEWERS AND STORM SEWERS

NOTE: THIS SECTION IS ADDED IN ITS ENTIRETY TO THE BLANK SECTION IN THE CALTRANS STANDARD SPECIFICATIONS.

Unless specifically differentiated herein, references to Sanitary Sewers also references Storm Sewers (aka. Storm Drains).

71-1.01 Description - This work shall consist of laying sewer pipe and constructing sewer structures as shown on the Project Plans, in accordance with these Standard Specifications and Plans, the Special Provisions and as directed by the Engineer.

The type of sewer pipe and sewer structures will be designated in the contract items.

71-1.02 Materials - Pipe, fittings, miscellaneous materials and the most common joint materials are described in this Section 71-1.02.

Portland cement used in the production of concrete products set forth in this Section 71-1.02 shall be Type II Modified cement conforming to the provisions in Section 90, "Concrete."

71-1.02A Reinforced Concrete Pipe (RCP) - Reinforced concrete pipe shall conform to A.S.T.M. Designation C-76 for the size and classes indicated on the Project Plans. For sanitary sewer applications, RCP shall be used only on sewer lines 36-inch and larger. All RCP sewers 36" and larger shall be coated with epoxy.

71-1.02B Clay Pipe - Vitrified clay pipe shall conform to the specifications for extra strength pipe of A.S.T.M. Designation C-700 and C-301.

71-1.02C Ductile Iron Pipe - Ductile iron pipe shall comply with ANSI A21.51 (AWWA C151).

71-1.02D Acrylonitrile-Butadiene-Styrene (ABS) Pipe (Sewer Pipe) – Pipe sizes four (4) inch and six (6) inch diameter shall conform to ASTM D2751-80 with minimum wall thickness determined by SDR 26.

Pipe sizes eight (8) through fifteen (15) inch diameter shall conform to ASTM D2680-80 with Type OR or Type SC joints.

71-1.02E Polyvinyl Chloride (PVC) Pipe - All solid wall pipe and fitting in 4" through 15" diameters shall be type PSM SDR-26 PVC, ASTM 3034; 18" through 24" shall be type PS 46 PVC, ASTM F679. Pipe and fittings shall be marked as per ASTM requirements.

Profile wall polyvinyl chloride pipe (PWPVC) may be used for pipe sizes 21-inch through 48-inch.

PWPVC shall be manufactured from a PVC compound having a minimum cell classification of 12364A as defined in ASTM D 1784. Gasket shall meet the requirements of ASTM F 477.

PWPVC shall be closed profile, ASTM F 1803-97 for 21" – 48" diameters with a bell and spigot gasketed joint. The joint shall meet the requirements of ASTM D 3212. The pipe shall have a minimum pipe stiffness when tested in accordance with ASTM D 2412.

Tests for compliance with this specification shall be made according to the applicable ASTM Specifications at the time of manufacturing. The manufacturer shall provide a certificate of compliance with this specification. In addition, the CITY may, at his own expense, station a representative or third party inspector at the site of manufacture to continuously monitor the manufacturing process, and to independently test the pipe to verify conformance with the project specification. Pipe tests and frequency shall be determined by the City.

PWPVC Nominal Dimensions:

Nominal Diameter (in.)	Outside Diameter (in.)	Inside Diameter (in.)
21	22.110	20.75
24	25.040	23.50
27	28.232	26.50
30	31.430	29.50
36	37.800	35.50
42	44.200	41.50
48	50.57	47.50

Unless otherwise approved by the CITY, all pipe shall be unloaded in the original packaging using a forklift with fork arms long enough to reach beyond the last pipe bundle. Do not roll the pipe off of the truck. Pipe shall not be handled or secured using chains or cables; a nylon or textile strap is recommended.

In addition to the requirements reflected in Section 71-1.05 Pipe Laying, the pipe bedding shall be carefully placed and compacted in the haunching. The haunching area extends from the bottom of the pipe to the springline of the pipe. Bedding shall be placed in 6" loose lifts on alternate sides of the pipe. A Tamping bar or shovel shall be used to facilitate bedding consolidation on the lower quadrant of the pipe. The bedding shall be mechanically compacted using hand operated equipment in accordance with the manufacturer's recommendations. The bedding material and its proper placement are the most important factors affecting the performance (side support) of the pipe.

Initial Backfill shall be placed to protect the pipe from dropping of large rocks, large mechanical compaction equipment or other impact loads that may occur during final backfill.

Pipe Deflection Testing: Pipe testing shall be performed in accordance with Section 71-1.11B.

71-1.02F Miscellaneous Iron and Steel - Miscellaneous iron and steel items shall conform to the provisions in Section 75, "Miscellaneous Metal."

71-1.02G Reinforcement - Reinforcement shall conform to the provisions in Section 52, "Reinforcement."

71-1.02H Concrete - Concrete shall conform to the provisions in Section 51, "Concrete Structures," and Section 90, "Concrete."

71-1.02I High Density Polyethylene Pipe (HDPE) - HDPE pipe and fittings shall be made of high density, high molecular weight, Type III, Class C, Category 5, Grade P34 polyethylene meeting the requirements of ASTM D1248 and ASTM F894 unless specified otherwise herein. Wall configurations and thicknesses shall meet the deflection requirements of this section. Crushing and buckling strengths shall exceed that required from the loads anticipated. Pipe selection and deflection design shall also be based upon a pipe stiffness not less than 20 psi and a modulus of soil reaction no greater than 1400. Pipe stiffness shall be tested prior to installation in accordance with ASTM D2412 with a 5% deflection at a rate of 1/2 inches per minute.

71-1.03 Excavation and Backfill - Excavation and backfill shall conform to the provisions shown on City of Stockton Standard Plans No. R-36 and R-41.

The pipe shall be laid in a trench excavated to the lines and grades designated by the Engineer. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel.

Suitable excavation shall be made to receive the bell of the pipe and the joint shall not bear upon the bottom of the trench. All adjustment to line and grade shall be made by scraping away or filling in with sand, gravel, or granular material under the body of the pipe, and not by wedging or blocking.

Trenches shall not be left open farther than 100 feet in advance of pipe laying operations or 100 feet to the rear thereof.

The excavation shall be supported so that it will be safe and that the ground alongside the excavation will not slide or settle and all existing improvements, either on public or private property, will be fully protected from damage.

All supports shall be removed after construction is completed and shall be withdrawn in a manner that will prevent the caving of the sides of the excavation. All openings caused by the removal of supports shall be filled with suitable material properly compacted.

71-1.04 Bedding - Bedding shall be defined as that material supporting, surrounding and extending to one foot above the top of the pipe. Where it becomes necessary to remove boulders or other interfering objects at subgrade for bedding, any void below such subgrade shall be filled with the bedding material designated on the Project Plans. Where concrete is specified to cover the pipe, the top of the concrete shall be considered as the top of the bedding.

If soft, spongy, unstable, or other similar material is encountered upon which the bedding material or pipe is to be placed, this unsuitable material shall be removed to the depth specified by the Engineer and replaced with bedding material suitably densified.

Bedding material shall first be placed so that the pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe equal to a minimum of 0.5 times the outside diameter of the barrel. Densification of bedding for pipe shall be accomplished after the sheeting or shoring has been removed from the bedding zone. Alternate methods of pipe laying which are recommended by the pipe manufacturer may be used if reviewed by the Engineer. The bedding zone for PVC, ABS, and HDPE pipe shall be mechanically compacted before the remainder of trench is compacted.

Bedding material shall be sand, gravel, crushed aggregate, native free-draining granular material having a sand equivalent of not less than 20 as specified on Standard Plans Nos. R-36 and R-41 for trench backfilling.

Pea gravel is not acceptable. No aggregate shall exceed 1".

In cases where native material is suitable for use as bedding, the trench may be excavated to point above the invert grade and the trench bottom hand-shaped so that the bottom segment of the pipe is firmly supported on undisturbed material.

Bedding material for HDPE, VCP, PVC, and ABS pipe shall be 3/4" crushed rock. The portion of the material that is larger than will pass a 3/8" sieve shall contain at least 50% of particles having three or more fractured faces. Not over 5% shall be pieces that show no such faces resulting from crushing. The gradation of the crushed rock shall be as follows:

<u>Sieve Size</u>	<u>¾"</u>
1 ½"	-
1 "	100
¾ "	90-100
½ "	30-60
3/8"	0-20
No. 4	0-5
No. 8	-

This material shall be compacted to the density and level shown on Drawing R-42.

71-1.05 Pipe Laying - Pipe shall be protected during handling against impact shocks and free fall. Pipe will be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection. Any corrective work shall be reviewed by the Engineer and shall be at no cost to the City.

When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose, the existing pipe improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made. When the new facilities interfere with the existing flow of sewage, the Contractor shall provide satisfactory bypass facilities at the Contractor's expense.

The pipe shall be laid without break upgrade from structure to structure, with bell end upgrade, unless otherwise permitted by the Engineer.

All joints shall be cleaned and then sealed with the type of materials specified or required by the City. In the absence of such requirements the pipe shall be jointed with materials recommended by the pipe manufacturer for the purpose intended, and reviewed by the Engineer, in order to obtain a watertight joint against leakage and infiltration under all conditions of expansion, contraction, and settlement.

Whenever the work ceases for any reason, the end of the pipe shall be securely closed with a tight fitting plug or cover.

Whenever existing pipes are to be cut or abandoned, the open ends of said pipes shall be securely closed by a tight fitting plug or wall of concrete slurry with a maximum density not to exceed 90 lbs/cubic foot not less than 0.5 foot thick, or by a tight brick wall 0.67 foot thick with cement mortar joints.

Where ground water occurs, the bottom of the trench shall be kept entirely free of water during the pipe laying, filling the joints, and as long thereafter as directed by the Engineer.

All joints shall be carefully cleaned on the inside.

Stoppers for pipes and branches left unconnected shall be made of the same material as the pipe or of resilient joint material conforming to Section 71-1.02J, "Resilient Joint Material." After placing the stopper, it shall be covered with a layer of sealant. The sealant shall be sufficiently fluid to insure free flow around the stopper.

Concrete pipe with elliptical reinforcement shall be laid with the minor axis of the reinforcement cage in a vertical position.

Pipe shall be laid true to line and grade. Any pipe, which is not in true alignment or shows any undue settlement after lying shall be taken up and re-laid at the Contractor's expense.

Pipe sections shall be laid and joined in such a manner that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum offset at the invert of pipe shall be 1 percent of the inside diameter of the pipe or 3/8 inch (9.5 mm), whichever is smaller.

In joining socket and spigot pipe, the spigot of each pipe shall be so seated in the socket of the adjacent pipe as to give a minimum of 3/8 inch (9.5 mm) annular space all around the pipe in the socket. Unavoidable offsets shall be distributed around the circumference of the pipe in such a manner that the minimum offset occurs at the invert.

Pipe shall be laid true to line and grade. Any pipe which deviates from the engineering alignment by 1/2" or grade by 1/4" or results in a reverse slope or shows any undue settlement after laying shall be taken up and re-laid.

After the joints have been made, the pipe shall not be disturbed in any manner.

During installation, linear expansion and contraction shall be kept below the manufacturer's recommendations. Strutting shall be mandatory for size 36" and larger. A strutting detail shall be reviewed by the City Engineer prior to installation. Pre-deflecting the pipe shall only be permitted subsequent to approval from the City Engineer.

71-1.06 Pipe Joints

71-1.06A Vitrified Clay Pipe - Either polyvinyl chloride or polyurethane compression joints may be used. Materials shall conform to A.S.T.M. Designation C-425.

Joints shall contain two sealing components, one bonded to the outside of the spigot and the other bonded to the inside of the socket. Sealing components shall be a plasticized polyvinyl chloride compound or polyurethane elastomer bonded to pipes and fittings at the pipe factory, and shall be cured to a uniform hardness and compressibility. The sealing components shall be shaped, sized, bonded, and cured in such a manner as to form a tight, dense, and homogenous compression coupling when the joint is assembled. Any imperfection in the sealing components will be cause for rejection.

Upon installation, the meeting surfaces shall be wiped clean of dirt and foreign matter, then an approved lubricant shall be applied to the joint surfaces. The spigot shall be positioned inside the socket and the joint shoved home. For large diameter pipe, a lever attachment or bar cushioned with a wooden block shall be used to shove the joint into place.

In no case shall a bar be used on an unprotected joint surface. Mating surfaces shall be in tight contact with each other upon completion of the joint installation.

Polyvinyl chloride joints may be used on curves, provided that the radius of curvature is not less than shown in the following table, unless beveled pipe or shorter lengths are provided:

Pipe Size Inches	Maximum Pipe Length Feet	Minimum Radius of Curvature Feet	Maximum Deflection
6	5	100	2° 00'
8	5	100	2° 00'
8	6	115	2° 00'
10	5	185	1° 33'
10	6	220	1° 33'
12	5	215	1° 20'
12	6	260	1° 20'
15	5	275	1° 03'
15	6	330	1° 03'

Polyurethane joints may be permitted for use on curves, provided that the radius of curvature is not less than shown in the following table, unless beveled pipe or shorter lengths are provided.

Pipe Size Inches	Maximum Pipe Length Feet	Minimum Radius of Curvature Feet	Maximum Deflection
6	5	100	2° 00'
8	5	100	2° 00'
8	6	115	2° 00'
10	5	170	1° 41'
10	6	205	1° 41'
12	5	150	1° 54'
12	6	180	1° 54'
15	5	190	1° 32'
15	6	225	1° 32'
18	5	225	1° 16'
18	6	275	1° 16'
21	5	265	1° 06'
21	6	315	1° 06'
24	5	240	1° 12'
24	6	290	1° 12'
27	5	270	1° 04'
27	6	325	1° 04'
30	5	300	0° 58'
30	6	360	0° 58'
33	5	275	1° 03'
33	6	330	1° 03'
36	5	295	0° 59'
36	6	355	0° 59'
39	5	325	0° 54'
39	6	385	0° 54'
42	5	345	0° 50'
42	6	415	0° 50'

71-1.06B Reinforced Concrete Pipe. All reinforced concrete sanitary sewer pipe shall be joined with rubber gasket joints.

Rubber gasket joints shall conform to the requirements of A.S.T.M. Designation: C443 and shall be flexible and able to withstand expansion, contraction and settlement.

All rubber gaskets shall be stored in as cool a place as practicable, preferably at 70° or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

Rubber gaskets, of the type requiring lubrication, shall be lubricated with the lubricant recommended and supplied by the manufacturer of the pipe.

The ends of the pipe shall be so formed that when the pipes are laid together and joined, they shall make a continuous and uniform line of pipe with a smooth and regular surface.

Joints shall be water-tight and flexible. Each joint shall contain a solid gasket of rubber or other material approved by the Engineer, which shall be the sole element responsible for water-tightness of the joint. This gasket shall be of circular cross section unless otherwise approved by the Engineer. The length and cross sectional diameter of the gasket, the annular space provided for the gasket, and all other joint details shall be such as to produce a water-tight joint. The slope of the longitudinal gasket contact surfaces of the joint with respect to the longitudinal axis of the pipe shall not exceed 2°.

Under ordinary laying conditions, the work shall be scheduled so that the socket end of the pipe faces in the direction of laying. Prior to placing the spigot into the socket of the pipe previously laid, the spigot groove, the gasket and the inside of the socket shall be thoroughly cleaned. Then the spigot groove, the gasket and the first 2 inches (50.8 mm) of the inside surface of the socket shall be lubricated with a soft vegetable soap compound.

The gasket shall be uniformly stretched when placing it on the spigot so that the gasket is distributed evenly around the circumference. The gasket shall be lubricated as per manufacturer's recommendations.

For pipe in which the inside joints are to be pointed, suitable spacers shall be placed against the inside shoulder of the socket to provide the proper space between abutting ends of the pipe.

After the joint is assembled, a thin metal feeler gage shall be inserted between the socket and the spigot and the positions of the gasket checked around the complete circumference of the pipe. If the gasket is not in the proper positions, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe relaid, and the gasket position again checked.

71-1.06C Ductile Iron Pipe. Ductile iron pipe joints shall comply with the following requirements:

<u>Type of Joint</u>	<u>Specification</u>
Rubber Gasket Push-On Joint	ANSI A21.11 (AWWA C111)
Mechanical Joint	ANSI A21.11 (AWWA C111)
Flanged Joint	ANSI B16.1, B.16.2, and A21.10 (AWWA C110)
Flanged Joint (Threaded Flanges)	ANSI B2.1

All rubber gasket, push-on, mechanical and flanged joint fittings for ductile iron pipe shall be manufactured in accordance with ANSI A21.10 (AWWA C110).

Slip-On Joint - The gasket and gasket seal inside the socket shall be wiped clean before the gasket is inserted. A thin film of soft vegetable soap compound shall be applied to the gasket and the outside of the spigot end of the pipe. The spigot shall then be positioned inside the socket and shoved home. Lubricant other than that furnished with the pipe shall not be used.

Mechanical Joints - The outside of the spigot and the inside of the socket shall be thoroughly cleaned of foreign matter. The gland and gasket shall then be slipped onto the spigot end of the pipe. The gasket shall be pressed evenly into the socket only after the spigot is seated in the socket. The gland shall be brought up evenly by tightening alternately the nuts spaced 180° apart. Bolts and nuts shall be coated with mastic following tightening.

Flanged Joints - Flanged Joints shall be firmly and fully bolted with machine bolts of proper size. Full circle reinforced neoprene rubber gaskets 1/16" thick shall be used at all flanged joints. Bolts and nuts shall be coated with mastic following tightening.

71-1.06D ABS Sewer Pipe

1. Pipe lengths and fittings shall be joined by utilizing elastomeric gaskets as referenced in A.S.T.M. D-2680 and D-2751 and meeting the requirements of A.S.T.M. D-3212 "Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals," or solvent weld joints.

Solvent weld joint or usage shall conform to A.S.T.M. F-402 "Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings," and the following requirements:

- a. All ABS pipe joints, fittings and surfaces to be joined by solvent welding shall be connected with adhesive cement conforming to A.S.T.M. D2680 for ABS composite sewer pipe or to A.S.T.M. D2751 for 4-inch and 6-inch ABS solid wall pipe.
- b. Prior to joining ABS pipe joints, fittings and surfaces, dirt, mud or any other foreign material shall be thoroughly removed and cleaned from the joints, fittings and surfaces to be joined.
- c. A coat of adhesive cement shall be liberally and thoroughly applied to the joints, fittings and surfaces to be joined. After application of the adhesive cement, the pipe joints, fittings, and surfaces to be joined shall be immediately fitted and joined without interruption.

For bell and spigot connections, the spigot end of each pipe shall be fitted to the full depth of the bell socket.

- d. When the temperature is below 40° F., a primer shall be applied to the pipe surface to be cemented and joined.

2. Reducing Wyes:

- a. Reducing wyes for service laterals shall be either saddle type wyes or in-line bell and spigot type wye fittings. All reducing wyes shall be premoulded and factory fabricated.

- b. Saddle Fittings:

1. In addition to the solvent welding of the saddle to the main pipeline, the saddle type wye shall be attached to the main pipeline with a stainless steel clamp.
2. Tapping hole for saddle fittings shall be cut with a cutting instrument. The hole shall be of the same size and shape of the lateral pipe surface.

3. Exposed Pipe Cross-Sections:

Exposed cross-sections of the ABS composite sewer pipe shall be coated with adhesive cement prior to connection of pipe joints, fittings and surfaces.

4. Maintenance Hole Connections:

Maintenance hole connections shall be by rubber ring water stop installed on pipe and cast in center of maintenance hole wall or four (4) inches from outside face of maintenance hole base. Pipe section on water stop at maintenance hole shall have bell flush with outside of maintenance hole or no more than ten (10) inches outside maintenance hole.

71-1.06E PVC Pipe

1. All joints shall be integral wall bell and spigot configuration, factory formed in accordance with ASTM D3212. All rubber rings shall conform to A.S.T.M. F-477.
2. Reducing wyes for service laterals shall be in line bell and spigot type, factory moulded.
3. Saddle fittings for lateral connection will be permitted; solvent welded.
4. Maintenance hole connections shall be by rubber ring water stop installed on pipe and cast in center of maintenance hole wall or four (4) inches from outside face of maintenance hole base. Pipe section on water stop at maintenance hole shall have bell flush with outside of maintenance hole or no more than ten (10) inches outside maintenance hole.

71-1.06F HDPE Pipe

Joints for HDPE shall be bell and spigot or butt-fusion type. Bell and spigot types shall have an elastomeric gasket which will be compressed radially to form a watertight seal. The joint shall be designed to avoid displacement of the gasket when installed with the manufacturer's recommendations.

71-1.07 Deformation Testing - Following the placement and compaction of backfill and prior to placement of permanent pavement, the Contractors shall perform a deflection test on the pipe. If the pipe should fail the deflection test, the Contractor shall uncover the pipe and make adjustments in the bedding and/or backfill conditions that will be necessary to achieve a passing test. The trench shall be backfilled and street subgrade shall be recompacted and the pipe retested. Any corrective measures found necessary to meet the deflection requirements, including recompaction and regrading of the street subgrade, shall be included in the unit price bid for the sanitary sewer pipe.

See Section 71-1.11 for method and extent required.

- a. Maximum deflection for ABS composite sewer pipe installed is 4%.

71-1.08 Existing Maintenance Holes - Existing maintenance holes shall be adjusted to grade, remodeled or abandoned as shown on the Project Plans and in accordance with the provisions in Section 15, "Existing Highway Facilities."

When designated on the Project Plans, or directed by the Engineer, existing maintenance hole frames and covers shall be reset on new structures. Upon completion of the adjustment of existing maintenance holes to grade, the maintenance hole cover shall conform to the planned surface as specified for the finished asphalt concrete surface, Section 39.

All existing maintenance holes, lampholes and terminal cleanout frames and covers that are removed become the property of the City of Stockton.

71-1.09 Sewer Structures - New maintenance holes, terminal cleanout structures, and pipe chimneys for sewers shall be constructed in accordance with the details shown on the Standard Plans, as specified in this Section 71-1.09 and as directed by the Engineer.

Precast maintenance hole, pipe maintenance holes shall conform to the Standard Plans, the Project Plans, and the applicable sections in Section 70.

Maintenance hole frames shall be secured to the maintenance hole cover and riser barrels with full mortar bed or full circle concrete collar that will effectively secure the frame to the maintenance hole structure and provide a uniform bearing for the frame.

Concrete for sewer structures shall be Class A as described in Section 90-1.01. Concrete for sewer maintenance bases shall be Class B.

When the maintenance hole is located in the pavement area, it shall not be constructed to final grade until pavement has been completed.

Where new work is jointed to the surface of unfinished work, the latter shall be thoroughly cleaned.

All joints on the inside of structures and sewers shall be neatly struck and pointed where plastering is not specified on the plans.

The inside bottoms of existing maintenance holes, where new connections are made, and of new maintenance holes shall be shaped to provide channels conforming to the size and shape of the lower portion of the inlets and outlets of the maintenance holes. The channels shall vary uniformly in size and shape from inlet to outlet.

No pipe shall project more than 0.17 foot into a maintenance hole and in no case shall the bell of a pipe be built into the wall of a maintenance hole or structure.

All concrete shall be cured for a period of not less than 10 days after being placed and shall be protected from damage.

71-1.09A Maintenance Hole Interior Coatings

General - The interior of all new maintenance holes along sanitary sewer lines 24" and larger, which will be maintained by the City, shall be coated. In addition, the interior of any existing City Maintenance hole(s), downstream from a new Sanitary Sewer system, determined by the City Engineer, to be adversely affected by the additional sewage, shall be either lined or coated.

The coating shall be resistant to attack from the following: bleaches; sulfuric, acetic, hydrochloric, phosphoric, nitric, chromic, oleic, and stearic acids; sodium and calcium hydroxides; ammonium, sodium, calcium, magnesium, and ferric chlorides; ferric sulfate, hydrogen sulfides, petroleum oils and greases, vegetable and animal oils, fats, greases, soaps and detergents. The coating shall be impermeable to sewage gases and liquids and shall be non-conducive to bacterial or fungus growth.

Acceptable coatings are as follows (or approved equal):

<u>PRODUCT NAME</u>	<u>PRODUCT TYPE</u>	<u>MANUFACTURER</u>
SewerGard 210	Epoxy	Sauereisen
Raven 405	Epoxy	Raven Lining Systems
Hydro-pox 204	Epoxy	Con-Tech
Mainstay DS-4	Epoxy	Madewell Products Corporation
SprayWall	Epoxy	SprayRoq, Inc.

The City Engineer, at the City Engineer's discretion may, at any time, determine that a product is not suitable for specific applications. Additionally, this list may be reviewed annually by the Materials Review Committee and products may be determined not suitable for specific applications.

Surface Preparation - For coatings, it is the intent of this standard that the application surface be clean and dry. Surfaces shall be cleaned to achieve an ASTM D-4259 Standard by abrasive blast cleaning methods. All surfaces shall be cleaned to remove all dirt, dust, corrosion products, loose concrete, debris, grease, oils, growths and foreign matter. On new concrete and metal surfaces, a sandblasting shall be used to remove all laitance. Coatings shall be applied only to a sound clean surface profile consistent with the manufacturer's published recommendation.

New concrete shall be aged no less than 30 days prior to application.

Cracks, joints, eroded and damaged areas shall be sealed with a compatible grout/putty as recommended by the coating manufacturer prior to the application of the coating material.

Application - All coating materials shall be applied in a manner and thickness consistent with the manufacturer's published recommendation.

All coatings shall be applied in a manner consistent with all applicable environmental and health and safety regulations. At a minimum, during application, the applicators shall use protective clothing, eye protection, chemical resistant gloves, and air respirators.

The coating shall be free of blisters, pinholes, holidays, or discontinuities.

Inspection - All coating work shall be performed in the presence of the designated City construction inspector. All coating work done in the absence of the inspector is subject to rejection unless specifically allowed by the inspector. The inspector shall be provided access to the construction site and to those areas subject to the performance of work under this standard.

Testing - All testing shall be performed by the contractor in the presence of a City inspector. All lining and coating work shall be high-voltage spark tested at a minimum 125 volts per mil film thickness of coating. Contractor shall verify to the City that the test equipment is in proper working condition prior to spark testing. Use Tinker-Razor AP-W test equipment or approved equal.

Repairs of Holidays or Pinholes - All areas to be repaired, as determined by inspection and testing, shall be repaired in accordance with the product manufacturer's recommendations.

71-1.10 Trench Resurfacing - Trenches in existing streets, except streets which are to be closed or abandoned, shall be resurfaced with the type and thickness of bases, surfacing or pavement, as shown in these Standard Specifications and Plans. The Contractor shall proceed immediately to resurface any part of any excavation upon notice from the Engineer without waiting for completion of the full length of the sewer. All trenches shall be backfilled or covered at the end of each working day. Any temporary trench patching shall be approved by the City Engineer.

71-1.11 Testing:

71-1.11A Cleaning - Prior to performing tests, the pipe installation shall be thoroughly cleaned. Cleaning shall be performed by the Contractor by means of an inflatable rubber ball. The ball shall be of a size that will inflate to fit snugly into the pipe to be tested. The ball shall be controlled with a tag line. The ball shall be placed in the last lamphole or maintenance hole on the pipe to be cleaned, and water shall be introduced behind it. The ball shall pass through the pipe with only the pressure of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first maintenance hole where its presence is noted. In the event cement or wedged debris or a damaged pipe shall stop the ball, the Contractor shall remove the obstruction.

71-1.11B Deflection Test for ABS, PVC, (Solid Wall and Profile Wall), and HDPE Sanitary Sewer Pipe – A short-term deflection test shall be conducted no sooner than 30 days after the placement and densification of backfill. The Contractor shall furnish all equipment needed to complete this

test. The cost for the deflection test shall be included in the unit price bid for the sanitary sewer pipe.

For PVC pipe, the allowable short-term deflection shall be 5%. The minimum allowable I.D. (O.D. of the mandrel) shall be established by the pipe manufacturer.

For ABS Pipe - All mainline pipe shall be cleaned and then mandrelled to measure for obstructions (deflection, joint offsets, lateral intrusions, etc.). A rigid mandrel with a circular cross-section having a diameter at least 96% of the specified average inside diameter shall be pulled through the pipe. The method of measuring the deflection shall be reviewed by the City Engineer. Any pipe through which the mandrel will not pass shall be said to have failed and will be repaired by the Contractor at the Contractor's expense.

For HDPE pipe--maximum long term deflection for HDPE pipe shall be no more than 5%. Long-term deflection shall be calculated as the short-term deflection multiplied by a deflection lag factor based upon the average inside diameter of the pipe. In no case shall a deflection lag factor of less than 1.5 be accepted. Mandrel deflection tests may be required during installation as specified by the City Engineer. Mandrels used in testing shall have an odd number of legs totaling no less than nine. Pipe sections not meeting the deflection requirements shall be excavated, re-installed, and subject to an additional 30-day deflection test.

At the Engineer's option, the Engineer may require a sample of ten percent (10%) of the laterals randomly selected by the inspectors shall also be tested for deflection. If difficulty is encountered in passing the mandrel test, the inspector may direct that a larger sample of laterals be tested up to and including one-hundred percent (100%) of all laterals.

The Contractor shall furnish properly sized mandrels for size and type of pipe installed. Certification of proper mandrel size shall be required and mandrel identified in a manner to identify with certification.

At the Contractor's expense, all locations with deflection greater than allowable shall be excavated, repaired or replaced, backfilled and retested.

71-1.11C General - All leakage tests shall be completed and approved following the placement and densification of the back fill, but prior to placing of permanent surfacing.

When leakage or infiltration exceeds the amount allowed by the specifications, the Contractor at its expense shall locate the leaks and make the necessary repairs or replacements in accordance with the specifications to reduce the leakage or infiltration to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests. Leakage tests shall be made on completed pipelines as follows:

1. Gravity Sanitary Sewer (24 inches (610 mm) or less in diameter where difference in elevation between inverts of adjacent maintenance holes is 10

feet (3.05 M) or less) - Water exfiltration test or water infiltration test as directed. The Engineer may allow substitution of an air pressure test for the water exfiltration test.

2. Gravity Sanitary Sewers (24 inches (610 mm) or less in diameter where difference in elevation between inverts of adjacent maintenance holes is greater than 10 feet (3.05 M)) - Air pressure test.
3. Gravity Sanitary Sewers (greater than 24" (610 mm) in diameter) - Air pressure test or water infiltration test as directed.
4. Pressure Sewers (force mains) - Water pressure test at 50 psi (345 kPa) over pipe pressure classification or designation.

71-1.11D Water Exfiltration Test - Each section of sewer shall be tested between successive maintenance holes by closing the lower end of the sewer to be tested and the inlet sewer of the upper maintenance hole with stoppers. The pipe and maintenance hole shall be filled with water to a point 4 feet (1.22 M) above the invert of the sewer at the center of the upper maintenance hole; or if ground water is present, 4 feet (1.22 M) above the average adjacent ground water level.

The allowable leakage will be computed by the formulae:

$E = 0.0001 LD \sqrt{H}$ for mortared joints.

$E = 0.00002 LD \sqrt{H}$ for all other joints.

where:

L is the length of sewer and house connections tested, in feet.

E is the allowable leakage in gallon per minute of sewer tested.

D is the internal diameter of the pipe in inches.

H is the difference in elevation between the water surface in the upper maintenance hole and the invert of the pipe at the lower maintenance hole; or if ground water is present above the invert of the pipe in the lower maintenance hole, the difference in elevation between the water surface in the upper maintenance hole and the ground water at the lower maintenance hole.

However, the maximum shall not exceed 200 gallons per inch of internal diameter per mile per day.

The Contractor shall, at its expense, furnish all water, materials and labor for making the required test. All tests shall be made in the presence of the Engineer.

71-1.11E Water Infiltration Test - If, in the opinion of the Engineer, ground water is encountered in the construction of a section of the sewer, the Engineer may require the pipe be tested by the Water Infiltration Test as follows:

The end of the sewer at the upper structure shall be closed sufficiently to prevent the entrance of water, and pumping of ground water shall be discontinued for at least 3 days, or until the ground water has recovered its normal status level, after which the section shall be tested for infiltration.

The infiltration into each individual reach of sewer between adjoining maintenance holes shall not exceed that allowed by the formula in Section 71-1.11D where H is the difference in the elevation between the ground water surface and the invert of the sewer at the downstream maintenance hole.

Unless otherwise specified, infiltration will be measured by the Engineer using measuring devices furnished by the City.

All visible leaks shall be repaired by the Contractor regardless of volume involved.

71-1.11F Air Pressure Test - The Contractor shall furnish all materials, equipment and labor for making an air test. Air test equipment shall be approved by the City prior to the beginning of the test.

Each section of sewer shall be tested between successive maintenance holes by plugging and bracing all openings in the main sewer line and the upper ends of all sewer connections. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released, the leaks eliminated, and the test procedure started over again.

The final leakage test of the sewer main line and branching sewer connections, shall be conducted in the presence of the Engineer in the following manner:

1. Clean pipe to be tested by propelling snug fitting inflated rubber ball through the pipe with water.
2. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
3. If the pipe to be tested is submerged in ground water, insert a pipe probe by boring or jetting, into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to ground water submergence over the end of

the probe. All gauge pressures in the test should be increased by this amount.

4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
5. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
6. When pressure decreases to 3.5 psig, start stop watch.
- 6a. The following applies to all pipes other than PVC and ABS (see 6b):

Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times are indicated by the following formula and table in seconds:

$$t = k \left(\frac{d}{g} \right)$$

where t = minimum required time in seconds

k = constant 0.022

d = nominal pipe diameter in inches

g = allowable air loss rate per unit
area, 0.003 cu. ft./min./sq. ft.
of internal/surface area

psig = pounds per square inch gage

**MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP
FROM 3 ½ TO 2 ½ PSIG**

PIPE DIAMETER

		4"	6"	8"	10"	12"	15"	18"	21"	24"	27"	30"	33"	36"	39"
LENGTH OF LINE IN FEET	25	4	10	18	28	40	62	89	121	158	200	248	299	356	418
	50	9	20	35	55	79	124	178	243	317	401	495	599	713	837
	75	13	30	53	83	119	186	267	364	475	601	743	898	1020	1105
	100	18	40	70	110	158	248	256	485	634	765	851	935		
	125	22	50	88	138	198	309	446	595	680					
	150	26	59	106	165	238	371	510							
	175	31	69	123	193	277	425								
	200	35	79	141	220	317									
	225	40	89	158	248	340									
	250	44	99	176	275										
	275	48	109	194	283										
	300	53	119	211											
	350	62	139	227											
	400	70	158												
	450	79	170												
	500	88													
	550	97													
	600	106													
	650	113	170	227	283	340	425	510	595	680	765	851	935	1020	1105

NOTES: (1) TO BE USED WHEN TESTING ONE DIAMETER ONLY

(2) The above air pressure test procedure is based on ASTM C828. Any special situations or conditions shall conform to this ASTM Standard.

- 6b. For PVC and ABS lines the following table lists the minimum times allowed for a pressure drop from 3.5 psi to 3.0 psi in excess of the ground water pressure at the top of the pipe.

Pipe Dia (in)	Min Time (min sec)	Lgth for Min Time (ft)	Time for Lngr Lgth (sec)	Specification Time for Length (L) shown (min:sec)								
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft	
4	1:53		.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50		.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47		.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	5:42
10	4:43		1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	8:54
12	5:40		1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	12:50
15	7:05		2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	20:02

SAFETY NOTE:

The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 lbs. is exerted on an 8" plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

As a safety precaution, pressurizing equipment should include a regulator set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the maintenance holes during testing.

IF THE TIME LAPSE IS LESS THAN THAT SHOWN IN THE TABLE, THE CONTRACTOR SHALL MAKE THE NECESSARY CORRECTIONS TO REDUCE THE LEAKAGE TO ACCEPTABLE LIMITS.

71-1.11G Televising of Sanitary Sewers - Following the placement and compaction of backfill and completion of other required testing, but prior to the placing of pavement, the Contractor shall televise all sewer lines for conformance to the Project Plans and specifications. A CD and log of the televising shall be delivered to the Engineer within a week of televising. If defective pipes or conditions are discovered they shall be corrected at no cost to the City. Any corrective work proposed shall be approved by the Engineer.

The City may also televise sewer lines prior to the expiration of the one year warranty. If a defective condition is found, it shall be presumed to be caused by defective workmanship or materials. The developer and/or Contractor shall be notified and shall correct the work in a manner approved by the Engineer.

71-1.12 Measurement - Sewer work performed under Section 71, "Sewers," will be designated in the contract item by size, type, thickness, quality, or whatever information is necessary for identification.

The lengths of the various types of sewer pipe to be paid for by the linear foot; measured from centerline of maintenance hole to center line of maintenance hole between structures or to end of line not terminated at a structure.

Pipe bends, wyes, tees and other branches will be measured by the linear foot for the sizes of pipes involved. Bends will be measured along centerlines. Wyes, tees, and other branches will be measured along centerlines to the point of intersections.

Quantities of precast concrete pipe sewer maintenance holes, terminal cleanout structures, and pipe chimneys will be determined as units from actual count, except new frames and covers.

New frames and covers will be considered as a part of the structure to which the frame and cover is attached and no additional compensation will be allowed therefor.

The quantities of permanent trench resurfacing to be paid for shall be the actual quantities placed within limits up to a maximum width of 3 feet greater than the outside diameter of the pipe or structure. Temporary trench resurfacing shall be paid for by the Contractor.

Trench quantities in excess of the above shall be at the Contractor's expense unless approved otherwise by the Engineer.

71-1.13 Payment - Items of work, measured as provided in Section 71-1.12, "Measurement," will be paid for at the contract price per linear foot for the various sizes of pipes, types of sewer maintenance holes, terminal cleanout structures, and the contract price per ton or square foot for the various types of surfacing.

Full compensation for structure excavation; structure backfill; bar reinforcing steel and concrete will be considered as included in the contract price paid for the various items of sewer work and no separate payment will be made therefor.

Shaping the bottoms of new maintenance holes will be considered as a part of the maintenance hole and no separate payment will be made therefor.

Full compensation for all tunneling and jacking of pipe, capping open ends of pipe, joining of pipe to other pipe or structure, shaping bottoms of existing maintenance holes, utility support and

protective work operations required to accommodate or safeguard public traffic, testing the sewer line, furnishing and disposing of water and equipment used for testing and all other incidental work and material required to construct the sewer system shall be considered as included in the prices paid for the various contract items of sewer work and no additional compensation will be allowed therefor.

The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing sewers, complete in place, as shown on the Project Plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

71-1.14 Abandonment - Sanitary sewer lateral abandonment shall be done at the property line. Provide bell end or collar with air tight plug, as specified in the U.P.C., at the end of the line.

SECTION 74

PUMPING EQUIPMENT AND CONTROLS

This section of Caltrans Standard Specifications is deleted in its entirety.

Replace with the following:

Specifications and Plans for pumping plant equipment shall be prepared in accordance with the Municipal Utilities Department Pump Station Guidelines and as approved by the Director of Municipal Utilities.

SECTION 75

MISCELLANEOUS METAL

75-1.02B Maintenance Hole Frames and Covers – The following shall be added: Gray iron castings shall conform to and/or exceed the requirements of ASTM A48-76, Class 30 and test bar size shall be as stated in Table I.

A "Certificate of Compliance" signed by an authorized agent of the manufacturer or supplier shall be required.

Each certificate so furnished shall be accompanied by a copy of test results stating that the material has been sampled, tested, and inspected in accordance with the provisions of the latest issue of ASTM A-48, Gray Iron Castings. Test bars shall be cast and tested for the first lot of casting and every four (4) months thereafter. If production is interrupted for any period longer than four months, test bars shall be cast and tested from the initial lot after production is resumed and every four (4) months thereafter. The first lot is defined as the first castings produced after January 1st of each year. The tension tests specified shall be performed and the results certified by an independent testing laboratory located in the United States of America.

In addition, current certified test reports for testing in accordance with AASHTO HS-20 loading shall be furnished.

Units furnished shall be identifiable with reference to the above tests.

Machined surface tolerances shall produce true, uniform bearing surfaces.

All frames and lids shall be interchangeable with like seat design. Dimensional fit tolerances shall not exceed those allowed on designated specified units detailed on Standard Drawing No. S-8.

Maintenance hole frame and covers and catch basin frames and covers shall be wire brushed removing all dirt and loose mill scale and rust and given a coat of coal tar pitch at 180° F.

75-1.02D Identifying Castings – All gray iron castings shall be marked on the top surface with the English name of the country of origin; manufacturer's name, lot number, and initials or logo type. In addition, the month and year of manufacture shall be cast on the frame and cover adjacent to the name of the manufacturer. Such marking shall be made by means of stamping, cast-in-mold lettering, etching, or engraving.

SECTION 78

DOMESTIC WATER FACILITIES

NOTE: THIS SECTION IS ADDED IN ITS ENTIRETY TO THE BLANK SECTION IN CALTRANS STANDARD SPECIFICATIONS.

78-1.01 Description - This work consists of furnishing and installing pressure water pipe control valves, thrust blocks, fire hydrant tees, fire hydrants and service lines, all as shown on the Project Plans or as directed by the Engineer, and as specified in the Standard Specifications and Plans and the special provisions.

78-1.01A Right of Way - All City owned domestic water facilities located on private property shall be installed within a 10' (min.) wide easement which shall have been dedicated to the City of Stockton.

78-1.01B Facilities Standards - Unless otherwise noted, all domestic water facilities shall be designed in accordance with the California Water Works Standards and the American Water Works Association.

78-1.02 Materials - All pipe and fittings (except valves) shall have a minimum working pressure of one hundred twenty five (125) pounds/square inch and conform to the following requirements:

78-1.02B Ductile Iron Pipe - Ductile iron pipe for water and other liquids shall be furnished in the sizes; classes; grades or nominal thicknesses; and joint types designated on the Project Plans or in the Special Provisions.

Ductile iron pipe shall comply with ANSI A21.51 (AWWA C151) and have cathodic protection and test stations.

Ductile iron pipe is to be used on all water crossings or where required by State Health Code sanitary sewer water line clearance regulations. Pipe shall utilize either flange, mechanical or push on rubber gasket joints. Pipe shall be minimum standard thickness with standard cement lining (USA Std. A21.4).

Ductile iron pipe joints shall comply with the following requirements for the types:

<u>Type of Joint</u>	<u>Specifications</u>
Rubber Gasket Push-on Joint	ANSI A21.11 (AWWA C111)
Mechanical Joint	ANSI A21.11 (AWWA C111)
Flanged Joint	ANSI B16.1, B.16.2 and A21.10 (AWWA C110)
Flanged Joint (Threaded Flanges)	ANSI B2.1.

All rubber gasket, push-on, mechanical and flanged joint fittings for ductile iron water pipe shall be manufactured in accordance with ANSI A21.10 (AWWA C110).

Unless otherwise specified, the internal surfaces of ductile iron water pipe and fittings shall be lined with a uniform thickness of cement mortar then sealed with a bituminous coating in accordance with ANSI A21.4 (AWWA C104). The outside surfaces of ductile iron pipe and fittings for general use shall be coated with a bituminous coating 1 mil (0.0254mm) thick in accordance with ANSI A21.6 or ANSI A21.51.

78-1.02C Polyvinyl Chloride (PVC) Pipe - Polyvinyl Chloride pipe shall be furnished in the classes, sizes, and grades designated on the Project Plans and Special Provisions.

Polyvinyl Chloride pipe shall meet the requirements of AWWA C-905 "Polyvinyl Chloride (PVC) Pressure Pipe." Pipe sized shall be 6" through 12" only - AWWA Class 150 minimum. All Class 150 pipe shall meet the requirements of DR 18 and Class 200 pipe shall meet the requirements of DR 14 with O.D.

However, pipe sizes from 16" through 24" may be used for transmission lines; no house service taps/laterals are allowed in these sizes. Pipe shall be DR-18 (235 psi) only, conforming to the requirements of AWWA C-905 "Polyvinyl Chloride (PVC) Water Transmission Pipe" in O.D. sizes. Pipe embedment zone (O.D. plus 12") shall conform to City of Stockton Standard Drawing No. R-36.

All pipes shall be suitable for use as a pressure conduit. Provisions shall be made for expansion and contraction at each joint with an "O" ring elastomeric gasket seal meeting the requirements of ASTM D-1869 and F-477. Solvent welded joints will not be permitted. The bell section shall be designed to be at least as strong as the pipe wall.

78-1.02D Valves - This specification includes three (3) inch through twelve (12) inch diameter gate valves and twelve (12) inch or larger diameter butterfly valves and operators intended for buried service in a domestic water system.

Gate valves shall be resilient seat C509 or equal meeting or exceeding the latest revisions of AWWA C-500 with a design working pressure of one hundred seventy-five (175) psi.

Butterfly valves shall meet or exceed the latest revisions of AWWA C-504 with a design working pressure of 150 psi. Operators for butterfly valves twenty (20) inches and smaller shall be Class 150; larger operator will be as specified in the special provisions and designed for actual line conditions as covered in AWWA C-504, Appendix A. Valve ends shall be mechanical joint or flanged in accordance with AWWA C-500 unless otherwise specified.

Valves for use with flanged pipe shall be cast with Class 125 flanges, dimensions and drilling shall conform to ASA B 16.1. Flange boltholes shall be spot faced if flange fillets interfere with both heads and nuts.

Tapping sleeves for A.C. and cast iron water mains shall be full body shell, with full body gasket or

split sleeve, end and side gasket seal. Inlet flange and tapping gate valve flanges shall be Class 125 flange. Tapping sleeves shall be M & H 1174 and 1274 (all sizes); Romac SST and Clow 3490-AS (over 12 inch only) or an approved equal. Taps for steel pipe, CMC and/or CML, will require review and approval by the City Engineer.

All stem seals, gate valves and butterfly valves, shall be O-rings only.

Wrench nuts shall be made of top grade cast iron, fitting the top of the valve stem and secured by nut or key. Wrench nuts shall be one and fifteen sixteenth (1-15/16) inch square at the top and two (2) inches square at the bottom.

Valves requiring operating wrenches exceeding six (6) feet in length shall have extension and guides installed in valve boxes.

The open direction shall be left (counter-clockwise) and the closed direction right (clockwise).

78-1.02F Valve Boxes - Valve boxes and covers shall conform to City of Stockton Standard Plan No. W-11.

78-1.02G Gaskets - Gaskets for flanged joints shall be full circle one-sixteenth (1/16) inch thick asbestos composition gaskets.

78-1.02H Thrust Blocks - Thrust blocks shall conform to City of Stockton Standard Drawings. Concrete for thrust blocks shall be Class B with one and one-half (1-1/2) inch max. size aggregate in accordance with Section 90 of the Standard Specifications.

78-1.02I Fire Hydrants - Fire hydrants shall conform to the requirements of the Fire Department of the City of Stockton as shown on the Standard Plan No. W-13 and the following:

- a. All hydrants shall comply with AWWA C502, latest revision.
- b. All operating valves shall be located below grade and protected by "break-off" features so that no water flows if hydrant is knocked off.
- c. Hydrant main valve seat shall be a minimum 5-1/4 inches.
- d. Hydrant valve shall be molded non-swelling rubber.
- e. Hydrant main valve seat shall be threaded into a bronze to bronze subseat.
- f. Hydrant bury shall be 36 inches from connection to ground flange. Materials to extend the length of bury shall be readily available.

78-1.02J Service Lines - Service lines up to and including meter connection shall be as detailed in City of Stockton Standard Plan Nos. W-3 and W-4, as applicable for the service intended and with the AWWA Standard C-800.

1. Service line connections are not permitted on pipe sizes 16" and greater.
2. Threads for line pipes shall be as specified in the AWWA standard for threads for underground service line fittings.
3. Type of service line pipe shall be limited to the following:
 - a. Copper water tube, Type K or ASTM B-88.
 - b. Ultra High Molecular Weight (UHMW) P.E. 3406, P.E. 3408, CS 255-63, Polyethylene as manufactured by ADS or an approved equal in one (1) inch iron pipe sizes only. Plastic pipe larger than one (1) inch and up to and including two (2) inch iron pipe sizes shall be PB 2110 Polybutylene. Connection of plastic pipe shall be made using Mueller 110 compression connections or approved equal.
 - c. Services two (2) inches and larger shall be considered as a special condition and will require the prior approval of the Water Superintendent and City Engineer.
 - d. Saddles or service clamps shall be used on all PVC taps and shall be designed specifically for PVC pipe. Saddles or service clamps shall be Rockwell No. 381 or approved equal.
4. Service lines, if abandoned, must be severed at the main.

78-1.02K Water Meters - Unless otherwise specifically noted, water meters will be purchased and installed by the City of Stockton.

For meters larger than two inch it will be the Contractor's responsibility to contact the City of Stockton prior to installation of meter boxes to ascertain the dimensions of the meters currently in stock.

It shall be the Contractor's responsibility to set meter box and service fittings in such a manner that City meter can easily be dropped in place. See Standard Plans for minimum clearance dimensions.

78-1.03 Installation

78-1.03A Installation of Water Mains

78-1.03A(1) Description - The Contractor shall, unless specified otherwise, furnish all material, equipment, tools and labor necessary to do the work required, and unload, haul and distribute all pipe, castings, fittings, valves, hydrants and accessories. The Contractor shall also remove pavement as stipulated; excavate trenches and pits to the required dimensions; excavate bell holes; construct and maintain all bridges for traffic control sheet, brace, and support the adjoining ground or structures where necessary; handle all drainage or ground water; provide barricades,

guards, and warning lights; lay and test the pipe, castings, fittings, valves, hydrants, and accessories; backfill and consolidate the trenches and pits; restore the roadway surface unless otherwise stipulated; remove surplus excavated material; clean the site of the work; and maintain the street or other surface over the trenches as specified. All connections to existing lines shall be flanged by fittings with isolation plates.

78-1.03A(2) Excavation - Trench excavation shall conform to the requirements of the City of Stockton Standard Plans No. R-36 and No. R-41.

The bottom of the trench shall be carefully graded as indicated in Section 71-1.03 of the Standard Specifications.

78-1.03A(3) Jacking - Jacking shall conform to the City of Stockton Standard Plan No. S-14.

78-1.03A(4) Pipe Laying - The pipe shall be handled with care at all times and in a manner that meets the approval of the Engineer. Extreme care shall be exercised in the use of any mechanical devices used in laying the pipe to avoid scarring or other damage.

The Engineer shall be the judge of whether a pipe is seriously damaged and any pipe so classified shall be permanently removed from the site of the work.

The inside of all pipes and couplings shall be free from dirt, grease, or other deleterious materials. The open ends of all pipe previously laid shall be adequately plugged water tight whenever pipe laying operations are suspended at the end of each work day, or for any other reason.

Select fine damp earth shall be placed and thoroughly compacted across the bottom of the trench to provide full support of all the pipe. Bells and/or couplings shall have soil removed to provide a uniform bearing.

In joining asbestos cement pipe, a thin coating of non-toxic and water soluble lubricant shall be applied to the entering level and back to the first machined shoulder of the pipe to be coupled. The rubber rings shall be set in the coupling grooves, and the couplings shall be placed between the pipe ends. The pipe shall be moved so that ends butt snugly against the rubber rings. A representative of the pipe manufacturer shall be present when the pipe laying commences in order to insure the proper installation of the pipe.

78-1.03A(5) Backfilling - Backfilling shall not be completed until the pipe has been properly installed to the satisfaction of the Engineer.

Backfill materials shall be placed on both sides of the pipe simultaneously to prevent any undue strain on the pipe.

Imported sand or an approved clean granular material free of all lumps and debris, passing 100% through the 3/4 inch sieve and having 5% to 20% passing the No. 200 sieve, with a minimum sand equivalent of 20 material shall be placed in the trench in six (6) inch layers to a depth of twelve (12) inches above the pipe and shall be hand tamped, or compacted to 85 percent relative compaction.

The balance of the trench shall be backfilled and compacted as shown by jetting or mechanical means on Standard Plans Nos. R-36, R-37, R-41, R-42, and R-43. This Standard shall be used as a minimum in all new construction unless otherwise noted in the Special Provisions.

Backfilling and bedding for P.V.C. pipe shall be performed in accordance with Section 71-1.04 Bedding of these Standard Specifications for P.V.C. pipe.

The Contractor shall do all excavating, loading, hauling, placing and compacting of the material in place.

All pipe damaged during construction operations shall be replaced by the Contractor at the Contractor's expense to the satisfaction of the Engineer.

78-1.03A(6) Trench Resurfacing - Trenches in existing streets, except streets which are to be closed or abandoned, shall be resurfaced with the type of thickness of bases, surfacing or pavement shown on the Standard Plans.

The Contractor shall proceed immediately to resurface any part of any excavation upon notice from the Engineer without waiting for completion of the full length of line.

78-1.03B(1) Testing - The test for hydrostatic pressure shall commence no sooner than seven (7) days after the last concrete thrust block has been cast with standard cement or at least after thirty-six (36) hours with high early strength cement, and after backfilling and compacting the trench to the plane upon which the asphalt concrete surfacing is to be placed. The Contractor shall take the necessary precautions to insure that the pipe fittings, couplings, valves, and other appurtenances are not displaced during the test. The pipe shall be filled with water at least twenty-four (24) hours prior to the time of the test. Each section of the completed pipe under test shall be subjected to a hydrostatic test pressure of one hundred twenty-five (125) pounds per square inch for two (2) hours. During this period of the test, all pipe shall be inspected for leaks, and any leaks failures, or imperfect construction revealed during the period of tests shall be corrected by the Contractor at the Contractor's own cost and expense.

After a satisfactory hydrostatic pressure test, the line shall be tested for leakage. The line shall be maintained at a sixty (60) pound per square inch pressure for seven (7) days. The leakage during this period shall not exceed 0.100 gallons for each inch of diameter for each joint for twelve (12) foot pipe lengths in the section under test in a twenty-four (24) hour period.

It shall be the Contractor's responsibility to locate and repair the points of line failure; fill, recompact the trench and retest the section of line in the event the line fails the leakage test.

78-1.03B(2) Interruption of Service - No valve or other control on an existing system shall be operated for any purpose by the Contractor. The City of Stockton will operate all valves, hydrants, blowoffs and curb stops.

78-1.03C Disinfecting Water Mains

78-1.03C(1) General –

1. The interior of all pipe, fittings, and other accessories shall be kept as free as possible from dirt, foreign material and bacteria at all times. During pipe laying operations, when bacterial contamination of interior pipe surfaces is obvious or suspected by the Engineer, the Engineer may order said surfaces to be swabbed with an approved bactericidal solution.

Disinfecting chemicals and additives shall comply with the requirements of Title 22, Division 4, Chapter 18 as Regulated by the State of California, Department of Health Services.

2. Disinfection of water mains shall be insured before permission for their connection to the City's water distribution system will be granted.

Chlorinated water may be disposed of in the sanitary sewer with prior approval from the Municipal Utilities Department (MUD). Without MUD approval, water must be dechlorinated and disposed of in the sanitary sewer. Chlorinated water or dechlorinated water shall not be disposed of in the storm drain system. Disinfecting water mains shall be performed after all water related appurtenances have been installed.

3. Bacteriological samples used to satisfy the disinfection requirement of section 78-1.03C shall be collected under the direction of a Public Works Department inspector, or the inspector's agent, by personnel trained in the proper techniques for obtaining bacteriological samples, and shall be analyzed by a laboratory certified by the California Department of Health Services. It is suggested that the project contractor to be present to insure that all parties agree to the appropriateness of the sample locations.
4. The Municipal Utilities Department Laboratory is certified to perform the required bacteriological analyses and can provide properly trained personnel to collect samples.
 - a. It is not required that the City laboratory perform these tasks. The inspector or contractor may choose to use the services of a commercial laboratory as long as all technical requirements are met.
 - b. The City laboratory may be called upon, at no additional cost to the contractor, to collect and analyze one set of samples, and if that test fails, one set of retest samples after reesterilization of the main as in section 78-1.03C4. Any sampling/analysis after the first retest will be billed to the contractor on a time and materials basis.

- c. The City laboratory requires that scheduling be done at least 48 hours in advance of the sampling event. Normally this is sufficient time to allow the person assigned to this task to schedule the field work and to insure sufficient facilities exist in the laboratory to complete the analysis.
 - d. The City laboratory provides these services to the Public Works Department, not the contractor. There will be no direct communication of analysis results to the contractor; the report of the results of analyses will be made only to the inspector, or the inspector's agent, who requested the test, and to the Deputy Municipal Utilities Department Director/Water & Collection System.
 - e. If the City laboratory cannot accommodate the requested time schedule, the inspector or contractor may choose to use a commercial laboratory for sample collection and/or analysis.
5. If a commercial laboratory is used, a copy of the analysis report will be forwarded to the Deputy Municipal Utilities Department Director/Water & Collection System.

78-1.03C(2) Isolation of New Mains - All new water lines shall be completely isolated from any existing main until they have been tested and disinfected to the satisfaction of the Engineer. New mains may be filled from existing mains only by temporary tap thereto and through a State Department of Health approved backflow prevention unit so as to provide positive backflow prevention provided by City of Stockton. When new main is properly disinfected and the isolation dam is removed from connection flange or other type connection is made, extreme care shall be exercised to prevent the entry of contamination. Connection fittings shall be thoroughly swabbed with an approved bactericide immediately prior to their installation.

Flush the mains thoroughly at the end of the contact period. The orthotolidine test shall show no more chlorine in the water leaving the main than in the water entering the main.

The Engineer will collect a sample for bacteriological examination in a sterile bottle provided by the laboratory. On the label, give date, address, and the estimate number for the job. Where possible the sample should be taken from a service located near the end of the chlorination section, otherwise, it may be taken through the same blowoff used for flushing the heavily chlorinated water out of the main so that the blowoff is sterilized.

If the bacteriological tests are unsatisfactory, the main shall be resterilized using Method No. 2, and the sterilization repeated, if necessary, until satisfactory results are obtained.

78-1.03C(3) Method No. 1 - H.T.H. Tablet Method - This method is preferred for short jobs and for small diameter pipe of any kind. It cannot be used where trench water has entered the main. The main cannot be flushed prior to sterilization, so the method requires that the pipe be kept clean during installation.

Using Permatex No. 1 as an adhesive, fasten the required number of tablets (see Table I) to the

inside top of each length of pipe. Tubes of Permatex may be purchased locally at any auto parts store. The tablets may be fastened to the pipe before it is placed in the trench providing the top of the pipe is marked to insure that the tablets are on the top of the pipe after installation.

When installing asbestos cement pipe, each butt end shall be treated by using a H.T.H. tablet as a piece of chalk. Fasten extra tablets to the beginning of the first length of pipe. To be sure that these tablets start to dissolve as the water enters the main, they should be placed in rows about half an inch above the bottom of the pipe. Use one tablet for each inch of diameter. For long runs, this should be repeated about every 500 feet.

When using dresser or similar couplings, an additional tablet shall be crushed and placed in the annular space between the coupling and the pipe. Fill the pipe very slowly and proceed as outlined under General Instructions.

78-1.03C(4) Method No. 2 - H.T.H. Solution with Hand Pump Method - This method is general in scope and shall be used when it is necessary to rechlorinate an existing main. When this method is used on a main coupled with dresser or similar couplings, a pinch of H.T.H. powder shall be placed in each coupling as the main is laid.

Equipment required includes an ordinary hand test pump, solution hose, and a five gallon can to contain the chlorine solution.

A compact and convenient assembly can be made by mounting the solution can and the pump on suitable board with a pipe connection from the tank on the suction side of the pump.

H.T.H. comes as a powder which shall be dissolved in water. Strong chlorine solutions should be handled with care since they are irritating to the skin and will damage shoes and clothes.

Make up chlorine solution according to Table II. The quantity required is estimated from Table II. An excess volume should be prepared so as not to empty the container before the job is complete.

Connect pump to main. Use a corporation cock for this purpose and make connection at or ahead of the inlet end of the new line.

After flushing the line thoroughly adjust flow by timing the period required to fill a five-gallon can.

Pump chlorine solution into the line at a rate of one gallon of solution in three minutes.

Continue pumping until orthotolidine tests on a sample taken from discharge end of line being treated shows a red color, or until the odor of chlorine is noticed.

After finishing application of chlorine, close valve or blow-off. Disconnect and flush pump thoroughly with fresh water.

Refer to instruction flushing and sampling.

If the above procedure has to be varied because of some unusual condition, it will be necessary only to regulate the pump, control the water flow, or adjust the strength of the chlorine solution to give a dose of at least 50 ppm.

TABLE I
NUMBER OF TABLETS REQUIRED FOR
MAIN STERILIZATION

Length of Section	Diameter of Pipe					
	2"	4"	6"	8"	10"	12"
13' or Less	1	1	2	2	3	5
18'	1	1	2	3	5	6
20'	1	1	2	3	5	7
30'	1	2	3	5	7	10
40'	1	2	4	6	9	14

TABLE II
CHLORINE SOLUTION STRENGTH
HAND PUMP METHOD OF MAIN CHLORINATION

Amount of Chemical in 5 Gallons of Solution

Discharge Rate GPM	H.T.H.
10	0.25 lbs.
20	0.50 lbs.
35	0.75 lbs.
50	1.00 lbs.
75	1.50 lbs.
100	2.00 lbs.

Choose a suitable discharge rate and determine the time required to apply the chlorine from Table III.

Compute the gallons of solution required by dividing this time by 3.

Use the above table to determine the strength of solution required. Example: If the estimate time from Table III is 35 minutes, 11-2/3 gallons will be required; and if the discharge rate is 50 GPM, the solution should contain one pound of H.T.H. in five gallons. Prepare fifteen gallons of solution so as

to be sure of having an adequate amount. Operate the hand pump at a rate of five gallons in fifteen minutes, or one gallon in three minutes.

TABLE III

Time in Minutes to Apply Chlorine to 100 Feet of Pipe

Discharge Rate GPM	2"	4"	6"	8"	10"	12"
10	2	7	15	26	41	59
20		3	7	13	20	29
35		2	4	8	12	17
50			3	5	8	12
75			2	4	6	8
100				3	4	6

The above table is used to estimate the time required to apply chlorine. For example: 700' of 8" main can be filled with chlorine solution in 35 minutes with a discharge rate of 50 GPM.

78-1.04 Measurement - The work to be performed under these Standard Specifications will be listed in the contract items by size, class type, or whatever information is necessary for identification.

The length of pipe to be paid for will be the slope length designated by the Engineer.

Pipe bends, wyes, tees, and other branches will be measured by the linear foot for the sizes of pipes involved.

78-1.05 Payment - Items of work, measured as provided in Section 70-1.04, "Measurement," will be paid for at the contract prices per linear foot for the various sizes and types of pipe; the contract unit prices per ton, cubic yard or square foot for the various types of surfacing required.

Full compensation for excavation, backfill, thrust blocks, testing, sterilizing and fittings will be considered included in the various contract items and no additional allowance will be made therefor.

78-1.06 Non-Potable Water Systems - Specifications and Plans for non-potable water systems shall be prepared in accordance with the Municipal Utilities Department's Non-Potable Water System Guidelines, and as approved by the Municipal Utilities Department

SECTION 79

STORM WATER BASINS

NOTE: THIS SECTION IS ADDED IN ITS ENTIRETY TO THE BLANK SECTION IN CALTRANS STANDARD SPECIFICATIONS DATED JULY 1992.

79-1.01 Definitions

“Detention Basin” – A facility which stores storm water for a relatively short time designed with type of metered outlet.

“Wet Detention Basin” – A lake having a metered outlet utilizing differential water levels for storm water detention purposes.

“Retention Basin” – A facility which stores storm water for an indefinite period of time not usually designed with a metered outlet.

79-1.02 Basin Notes

1. Storm water basins, shall only be allowed if downstream improvements are either not feasible or impractical from a cost standpoint at the time of development. Unless otherwise approved by the City Engineer, basins will not be considered a permanent means for handling peak storm runoff flows. A plan may be required outlining the proper abandonment of the basin in the future.
2. Basins shall be constructed such that the collection system drains into the basin by gravity. Basins designed with surface berms or levees may be subject to additional design criteria other than that stated below.
3. Basins constructed in the proximity of the airport may be subject to additional design criteria due to avigational concerns.

79-1.03 Detention Basin Design

79-1.03A Detention Basins With No Discharge Limitations

79-1.03A (1) Volume – One 10yr – 48hr event calculated by $V = \frac{CAR}{12}$. The rainfall value for a 10yr – 48hr event in Stockton shall be 3.12 inches.

where, C = Runoff Coefficient
 A = Area of Collection
 R = Rainfall Value = 3.12 inches
 V = Volume (acre-ft)

79-1.03A (2) Collection System – The starting point for hydraulic grade calculations in collection system design shall be the water surface in the pond generated by the volume of one 10yr – 48hr storm or the top of the inlet pipe, whichever is higher. Hydraulic grade shall be kept a minimum of 1 foot below the top of curb at any point in the subdivision.

79-1.03A (3) Water Surface – The maximum anticipated static water surface, determined by the volume criteria above. This water surface must remain at least 1 foot below the top of curb at the lowest point in the subdivision.

79-1.03B Detention Basins With Discharge Limitations – Design criteria shall be the same as that listed for detention basins without discharge limitations except for as follows:

79-1.03B (1) Volume – 150% of the 10yr – 48hr storm calculated by $V=1.5 \text{ CAR}/12$. The rainfall value for a 10yr – 48hr event in Stockton shall be 3.12 inches.

where, C = Runoff Coefficient

A = Area of Collection

R = Rainfall Value = 3.12 inches

V = Volume (acre-ft)

79-1.03B (2) Collection System – The starting point for hydraulic grade calculations in collection system design shall be the water surface in the pond generated by the volume of 1 10yr – 48hr storm or the top of the inlet pipe, whichever is higher. Hydraulic grade shall be kept a minimum of 1 foot below the top of curb at any point in the subdivision.

79-1.03B (3) Water Surface – The maximum anticipated static water surface, determined by the volume criteria above. This water surface must remain at least 1 foot below the top of curb at the lowest point in the subdivision.

79-1.03C Wet Detention Basins – Basins designed as lakes with the fluctuation of water levels allowing detention of storm water runoff may be allowed where feasible. These basins, however, may not be allowed in certain areas of the City due to avigational hazards posed by waterfowl. Volume, collection system, and water surface design requirements for these basins shall be the same as for all other detention basins and will depend on the specific discharge requirements at the given location. Inlet lines and structures shall direct all storm water flows into the basin.

79-1.03D Retention Basins – Retention basins shall not be allowed unless approved by the City Engineer.

SECTION 86

ELECTRICAL SYSTEMS

The following are to be added to the appropriate sections of Section 86 of the Cal Trans Standard Specifications:

86-1.06 Maintaining Existing and Temporary Electrical Systems – If any existing loop conductor, including the portion leading to the detector handhole or termination pull box, is damaged by the Contractor's operation (overlay, underground utility work, etc.), the Contractor shall re-install the loop conductor by installing a detector handhole(s) (where note exist) at the nearest appropriate lane line. All of the re-installed loop conductors shall be routed through the new detector handhole(s).

86-2.08E Signal Interconnect Cable (SIC) – Single mode fiber optic cable (minimum 12 strand) shall be installed from any new or modified traffic signal to the nearest available connection point on the City's fiber optic communication network. All electronic equipment necessary for the traffic signal to communicate with the City's central traffic control system shall be required.

2 ½" PVC (Schedule 80) interconnect conduit shall be installed between the new or modified traffic signal and the nearest available connection point on the City's fiber optic communication network. No. 6 pull boxes shall be installed at +/- 500 feet intervals over the length of interconnect conduit. All fiber strands shall be terminated in termination panels at either a traffic controller cabinet or fiber optic hub cabinet.

All fiber optic splicing necessary to provide Ethernet communication shall be included as part of new or modified traffic signals. All end electronic equipment necessary to provide Ethernet communication via the City's fiber optic network shall be included as part of new or modified traffic signals.

86-2.09B Installation - Traffic monitoring camera(s) shall be installed as part of new or modified traffic signals. Traffic monitoring camera(s) shall be either one pan-tilt-zoom (PTZ) camera or four fixed cameras per intersection. Fiber optic video/data modems (field and central) shall be installed to transmit the video images and data control (PTZ) between the traffic signal and the City's central traffic control system.

Emergency Vehicle Pre-emption detectors shall be installed on luminaire arms for each approach to a new or modified traffic signal. All accompanying electronic equipment necessary to send the pre-emption signal to the traffic signal controller shall be supplied and installed.

Only Traffic Rated Type B Detector Handholes (DH) (**triangular lid**) shall be used for loop installations. Home run conduit (Between DH and PB shall be a minimum of two inches (2") Rigid Metal Conduit or Schedule 80 PVC. The Detector Handholes shall be located at the lane line and about five feet (5') away from the corner of the loop. All loop wires shall have three feet (3') of slack in the pull box. All loop wires shall be routed through the Detector Handhole.

A maximum of eight loops (total of 16 loop wires) can be routed through one DH.

All loops shall be installed with Detector Handholes, unless site-specific exemption is provided by the City Traffic Engineer. In general, one DH is installed for left-turn lanes, and one for a set of four loops. One DH is installed for a set of advance loops.

SECTION 90

CONCRETE

The following is added to the appropriate sections of Section 90 of the Cal Trans Standard Specifications:

On reconstruction and removal projects which remove sidewalk, the sidewalk shall be replaced with a score pattern, either matching the existing pattern or meeting current sidewalk installation standards for new sidewalks, which most enhances the visual appearance of the whole sidewalk. The overall trend toward a specific pattern (new or existing) shall be considered in the decision. The Engineer shall make the final determination of the score pattern to be used.

The use of fly ash to improve the workability of concrete may be allowed subject to approval by the City Engineer. The amount of fly ash to be used shall be per an approved mix design. Substitution of fly ash or other mineral admixture in place of the required portland cement shall not be allowed.

Section 90-1.01C(3) Cementitious Materials - Additionally, for the purpose of these Specifications and Standard Plans, wherein referenced, in addition to the latest edition of the Cal Trans Standard Specifications the following shall apply for all reference to Class A or Class 2 concrete:

1. Structural Concrete – must contain at least 590 pounds of cementitious material per cubic yard.
2. Minor Concrete – Minor concrete must contain at least 505 pounds of cementitious material per cubic yard.

SECTION 100

STREET OPENING AND PAVEMENT RESTORATION REGULATIONS

NOTE: THIS SECTION IS ADDED IN ITS ENTIRETY TO THE BLANK SECTION IN CALTRANS STANDARD SPECIFICATIONS.

100-1.01 Excavation - Any trench cuts within the street right of way to access **or install** a utility line or any related facility in excess of four (4) square feet or four (4) feet long, whichever is smaller, shall be considered an excavation and requires an excavation permit, which will be issued as part of an encroachment permit.

100-1.011 Excavator – The applicant/permittee to whom an encroachment permit is issued for the purposes of excavation may be referred to, for purposes within this section, as the excavator for the project.

100-1.012 Excavation Permit – The Encroachment Permit that is issued for any work within the street right of way that meets the definition of an excavation as described in Section 100-1.01, above, shall be referred to as an excavation permit for purposes within this section.

100-1.013 Trench Cut Fee - All excavations as defined above are subject to the trench cut fee. The fee shall be collected as part of the encroachment permit fee for the project.

100-1.02 Moratorium

1. Newly constructed or resurfaced streets shall be termed moratorium streets within this section. Permission to excavate in newly constructed or resurfaced streets will not be granted for three (3) years after the completion of street overlays. An overlay consists of a ½ inch or thicker layer of asphalt. For those streets with chip seal, slurry seal coatings, or micro paving with less than ½ inch of new pavement, the moratorium shall be for three (3) years. Utilities shall plan well enough in advance to determine alternate methods of making necessary repairs to avoid excavating in newly resurfaced streets. Exceptions to the above policy are as follows:
 - A. Emergencies which endangers life or property.
 - B. Interruption of essential utility service.
 - C. Work that is mandated by City, State or Federal legislation.

- D. Service for buildings where no other reasonable means of providing service exists.
 - E. Other situations deemed by the City Engineer to be in the best interest of the general public.
2. To excavate in a moratorium street a waiver must be obtained.
- A. To request a waiver, the applicant must submit a written request to the City Engineer or his designee. The request must include:
 - 1) The location of the excavation.
 - 2) Description of the work to be performed.
 - 3) Why the work was not performed before the street was paved.
 - 4) Why the work can not be deferred until after the moratorium
 - 5) Why the work can not be performed at another location.
 - 6) Why is it justified to excavate a moratorium street.
 - B. Any excavation in the moratorium streets will be repaired with full lane paving on the street as follows: (See Drawing No. R-96, and refer to section 100-1.06 paving).
 - 1) Overlaid or reconstructed streets: All lanes that are affected shall be ground down 1.5 inches and repaved with 1.5 inches of asphalt concrete.
 - 2) Slurry sealed, chip sealed, or microsurfaced streets: All lanes that are affected shall be resurfaced per Section 100-1.06 paving.
 - 3) A minimum of one (1) ft. on either side of trench shall be resurfaced if the excavation is a lateral cut. For longitudinal trenches the entire length plus one (1) ft. on either end shall be resurfaced.
 - 4) Exception – Full lane width restoration shall not be required if the work is not considered an excavation as defined in section 100 – 1.01.

100-1.03 Permits - Any and all construction work within the city right of way shall be done by obtaining an encroachment permit. Anyone doing excavation work within the City of Stockton street right-of-way shall obtain an encroachment permit for the purposes of excavation in addition to any other permits required. This also applies to all City departments.

1. The permit application may be obtained at the City's Permit Center. A faxed copy may be obtained by calling 937-8900.
2. Except in an emergency, excavation permits shall be taken out in advance of excavation work. An emergency is considered to exist only when life or property is endangered or when an essential utility service is or may be interrupted during weekends, holidays, or between 5 p.m. and 8 a.m. of normal working days
3. The excavator shall notify the Permit Center and apply for an excavation permit for "emergency work" within four (4) hours after the Permit Center opens.
4. As a condition of the permit to excavate, the applicant shall have been provided an inquiry identification number by a regional notification center (Underground Service Alert, USA) pursuant to Section 4216, Chapter 1153, Assembly Bill #1606 of the California State Law.
5. Prior to applying for an excavation permit, the excavator must register with the Public Works Department. The owner or the contractor performing the work may apply for the permit. The owner of the facility shall determine who applies for the excavation permit. However, if the applicant is not the owner of the facility to be excavated, the applicant must provide documentation that the applicant is authorized to act on behalf of the owner.
 - A. The following must be provided to become registered to get an excavation permit:
 - 1) A Cash Deposit equal to 3% of the project cost with a minimum of \$1000 and a maximum of \$25,000. Companies working under a franchise agreement with the City are not required to post the cash deposit until they have violated the City standards or permit requirements.
 - 2) A current Business License.
 - 3) Current evidence of Insurance.
 - 4) 24 hr. Phone Number for emergencies.
 - 5) The name, telephone number, and mailing address (fax number, pager, and e-mail address if available) of the person who will receive all official correspondence from the Department.
 - B. If an account is past due or not in good standing, a permit cannot be issued until the account is brought into good standing. The account is past due if the fines are not paid and are deducted from the deposit. To bring the account to good standing, all fees and fines must be paid.

6. If an excavator damages other facilities during their excavation work:
 - A. They do not need another excavation permit if no additional excavation is required to repair the damaged facility. In this case the original permittee shall maintain the site and restore the pavement.
 - B. They need an additional excavation permit if additional excavation and trenches are needed to repair the damaged facility.

7. All applications shall include a plan indicating the following:
 - A. Name of the street to be excavated and the nearest cross streets.
 - B. Distance from the face of the curb.
 - C. Distance from the intersection.
 - D. The size of the excavation (length and width).
 - E. The location of any above ground facilities to be installed, showing:
 - 1) Distance from curb and any street facilities/furniture.
 - 2) Purpose of the facility.
 - 3) Size of the facility.
 - 4) Location of doors and door swing.
 - F. The location of any underground facilities to be installed showing:
 - 1) Conduits vaults, maintenance holes, pipes, etc.
 - 2) Structural detail and additional information for installation of the structures such as vaults and maintenance holes.
 - 3) The construction method of the structure to be installed.
 - 4) Construction detail, locations, size, design criteria and the purpose of the facility.

- G. Cross section of a typical trench indicating:
 - 1) The approximate depth of the facility to be installed.
 - 2) Trench backfill depth, compaction and layer depths.
 - 3) Pavement section detail (type and depths)
 - 4) Plans, structural details, and trench cross section must be signed and stamped by a licensed Civil Engineer, when legally required.
 - H. The plan may show the approximate location of the excavation provided that on an "as-built" plan, the exact location of the excavation is shown. This shall be submitted prior to the permit being finalized and filed.
8. Pre-Construction meeting:
- A. A pre-construction meeting shall be held for all projects that are scheduled to take longer than 15 working days to complete.
 - B. The owner, contractor, any other agency that is involved and the Public Works Department shall attend this meeting.
 - C. There will be a fine for projects that are supposed to be completed within 15 days, and are not completed within the allowed time, if a pre-construction meeting was not held.
 - D. A traffic control plan shall be provided with the submittal of the application, and approved prior to the pre-construction meeting.
9. Permit duration shall be indicated on the permit:
- A. All permits shall include estimated start and completion dates. A permit is valid from the construction start date specified on the approved permit until the specified completion date.
 - B. Excavation permits are not valid if other required permits are not obtained or required notifications are not given.
 - C. No disruption of traffic is allowed after 3:00 PM and before 9:00 AM unless specifically approved for these hours.
 - D. Some permits may be valid on specific dates. They may be approved with special conditions specifying the dates:

- 1) When work shall not be done.
 - 2) When work must be completed.
 - 3) Before which work shall not start.
- E. Permits expire and become void unless otherwise amended:
- 1) Thirty days after the start date, if no work has begun.
 - 2) If the work is not diligently prosecuted and there are long delays after the work has started.
 - 3) When the excavation, including the trench restoration is not completed within the duration specified on the permit or on the date specified on the permit as the expiration date.
- F. The work is determined to be proceeding diligently if:
- 1) Once a project begins, work continues on a daily basis, except for weekends, holidays, inclement weather, labor disputes or any other emergency.
 - 2) Once a project begins, the work continues uninterrupted until such work no longer affects public convenience, health or safety. If the project is a multi agency project, a one-week time will be allowed for one agency to move out and another to move in to complete their work.
 - 3) The permittee ensures that all necessary materials and supplies are on hand and ready for use so as not to delay the excavation and the prompt restoration of the public right-of-way.
10. A valid permit may be extended by:
- A. Requesting an extension prior to the expiration date by:
- 1) Specifying the dates that need to be changed
 - 2) Explaining why an extension is needed.
11. All the excavation permit fees are due at the time the permit application is submitted.
- A. Checks should be made out to the City of Stockton. The check shall include:

- 1) The permit number
 - 2) The type of fees being paid (Administration fee, Inspection, extension, reapplication, etc.)
 - 3) All the fees, fines and penalties, not collected with the application will be billed by the city and shall be paid within 30 days. If they are not paid within 30 days, then these fees, fines and penalties will be deducted from the deposit. Utility companies working under a franchise agreement have 90 days to pay. If a contractor working for a utility company does not pay, the owner/utility company will be responsible to pay these fees, fines, and/or penalties.
 - 4) If a violation occurs and the fines are deducted from the deposit, no other application will be processed until the deposit has been put in place with the city and all conditions are met. For companies without a deposit, if the fines are not paid on time, no other permit will be issued.
12. If an application has been withdrawn or an approved permit is cancelled prior to the start of work:
- A. Inspection fee and trench cut restoration fees will be refunded.
 - B. To request a refund a written request must be submitted to the City Engineer.
 - C. The request shall include:
 - 1) The reason for cancellation or withdrawal
 - 2) The application number
13. By accepting an excavation permit, the permittee and the owner of the facility(ies) for which the permit has been issued agree:
- A. To follow all rules, regulations, special conditions, and code requirements.
 - B. To assure that their employees, contractors, and subcontractors comply with all rules, regulations, permit conditions and code requirements.
 - C. To defend and indemnify the City as required by the contract.
14. The excavation permit must be available during work periods at the excavation

site, until the project is completed and signed off by the City. Permit must be shown to the city employees on request.

15. The City and various utility companies must coordinate their Capital Improvement Programs. This information shall be shared through the monthly utility coordination meeting.

The information about any planned work in the street right-of-way shall be shared at the earliest possible time.

Various utility owners are encouraged to coordinate their excavation of the streets so that all work is done simultaneously and that the street is not excavated frequently within the same year.

16. The excavator shall provide public notifications when excavating in the public right-of-way.

- A. Provide 11"x17" posters with 1-inch minimum letters at beginning and end of the project and every 300 feet in between. Notes must contain:

- 1) The names, address, and telephone number of the owner and the permittee.
- 2) The start and completion dates of the project.

- B. Major projects lasting 15 working days or longer, the excavator shall:

- 1) Mail notices to or notify, after the permit has been issued but no more than 30 days before the anticipated start date of work:
 - a) Property owners, residents, or occupants of the affected blocks.
 - b) Schools and churches in the area and the San Joaquin Regional Transit District.
 - c) Provide the City with a copy of the notice.
- 2) At least 5 days but not more than 15 calendar days prior to starting construction, post and maintain 11" X 17" notices at beginning and end of the project and every 300 feet in between and deliver a copy of same notice to each dwelling unit on the block. The notices must contain:

- a) The name, address, and telephone number of the owner and the permittee.
 - b) A description of the project.
 - c) The start and completion dates of the project.
 - d) The name, address and 24-hour telephone number of a contact person.
17. A project sign is required for all major projects to be installed at either end of the project. The location for the sign to be worked out by the excavator and the City.
- A. The sign shall be a minimum of 24" x 36" with 2" minimum letters. It shall be hung on 4" x 4" wooden posts or a standard metal sign posts and include:
- 1) Project name, description, and Permit number.
 - 2) Permittee's name, address and 24 hour phone.
 - 3) Owner's name.
 - 4) Start date and completion date of the project.

100-1.04 Excavation Material

1. Pavement shall be cut to a straight, neat, vertical line prior to excavation.
2. All excavated material not suitable for backfilling shall be removed from the job site within twenty-four (24) hours. Excavated material suitable for backfilling may be stored on the job site for a maximum of five (5) working days, provided it does not occupy any more street space than the permit allows and provided this material is completely prevented from blowing, washing, or being thrown about at all times. Material may be stored on the adjacent private property if a written approval from the property owner has been obtained.
3. No trench shall be opened on any street that is not backfilled or plated at the end of the same day. Fines will be charged if any trench is left open.

100-1.05 Backfill

1. Trenches shall be backfilled with sand or suitable site excavated material. Compaction of backfill shall be in accordance with Drawing No. R-36 or R-37.
2. When undermining occurs, remove existing pavement as required to compact the backfill and restore the pavement.

3. Each encroachment permit will specify the number of compaction tests required. Each compaction test shall be certified by an independent laboratory and submitted to the City Encroachment Permit Inspector. If the results of compaction test show generally poor or marginal compliance with City compaction requirements, the number of compaction tests may be increased by the Engineer to help insure that proper compaction is being achieved.
4. A CONTROL NUMBER SHALL BE OBTAINED by calling (209) 937-8900 one (1) day in advance of the start of work on any encroachment permit. A copy of the permit and control number shall be on site during the construction.

100-1.06 Paving

1. Trenches shall be paved as shown on Drawing No. R-36 or R-37. After the trench has been backfilled and immediately prior to placing asphalt concrete, the existing asphalt concrete shall be saw cut, or milled according to City Standards, to a vertical face. New AC paving shall be butt joined to the existing asphalt concrete vertical face. No feathering of new paving to existing paving is allowed. The vertical faces shall be tack coated. In moratorium streets, placement of the final one and one-half (1 ½) inches of AC wearing surface shall be done by a paving machine or spreader box. Asphalt concrete shall be delivered and compacted in accordance with the Standard Specifications and Plans

To allow for proper placement of the new pavement section, damaged pavement outside of the original trench cut lines shall be removed by cutting in lines perpendicular to or parallel to the original trench lines. No diagonal cuts are to be made. Undamaged pavement of three (3) feet or less between two damaged areas shall also be removed. (See Drawing No. R-38)

2. Pavement will be restored using the "T Section" shown on Drawing No. R-36.
3. For trenches in moratorium streets parallel to the centerline of the street, the entire lane shall be key-cut one and one-half (1 ½) inches, deep and repaved with asphalt concrete. For trenches in moratorium streets with chip seal or slurry seal coatings, the entire lane shall be resurfaced with these coatings.
4. Trenches in concrete streets shall be paved with concrete pavement. The thickness of the new pavement shall be equal to the thickness of the existing pavement with the minimum thickness to be six (6) inches in the roadway.
5. Trenches in arterial streets, with asphalt wearing surfaces, shall be paved with not less than eleven and one-half (11 ½) inches asphalt concrete topped with one and one-half (1 ½) inches of asphalt concrete wearing surface or match the existing pavement if it is more.

6. Trenches in local and collector streets shall be paved with not less than six and one-half (6 ½) inches asphalt concrete topped with one and one-half (1 ½) inches of asphalt concrete wearing surface or match the existing pavement if it is more.
7. Pavement shall be restored within fourteen (14) working days from the time the entire trench is backfilled. For minor excavations such as service installations, the pavement shall be restored within thirty (30) working days from the time the entire trench is backfilled. The asphalt concrete wearing surface shall be placed within five (5) working days after placement of asphalt concrete base, weather permitting.
8. Asphalt pavement shall be compacted to obtain a minimum of ninety-five percent (95%) of relative compaction. The asphalt concrete wearing surface shall have no irregularity greater than five-sixteenths of an inch (5/16") in ten feet (10') in any direction.
9. On collector and arterial streets steel plates shall be used when ordered by the permit inspector to facilitate traffic flow and to protect the excavation until finished pavement is restored. Steel plates used to bridge a street opening shall be ramped to the elevation of the adjacent pavement and secured against movement in any direction. Temporary ramps shall be constructed of asphalt and shall have a gradual slope. On all other streets, temporary asphalt cutback is permitted.
10. After trench paving, utility trenches shall be color-coded with the 4" stenciled initials of the company doing the trench. These initials will be prescribed by the City of Stockton as stated below and the color shall be as prescribed by the Underground Service Alert (USA). The initials shall be stenciled on the existing asphalt adjacent to the new trench. When paving is complete, the initials shall be painted, using Krylon (or an approved equal), at the beginning and end of each trench and at each intersection, if applicable. The use of colored identifying disks in place of painting is allowed.

<u>Company</u>	<u>Color</u>	<u>Initials</u>
PG&E - Electric	Red	PG&E
PG&E - Gas	Yellow	PG&E
Pacific Bell	Orange	PB
Cable TV	Orange	TV
Cal Water	Blue	CW
City of Stockton - Water	Blue	COS
City of Stockton - Electric	Red	COS
City of Stockton - Sewer	Green	COS

Any agency not listed above must contact Public Works to be assigned initials before performing any excavation or trenching activities in the City of Stockton.

USA Codes are:

Electric	Red
Gas-Oil	Yellow
Communication - CATV	Orange
Water	Blue
Sewer	Green
Temporary Survey Markings	Pink
Proposed Excavation	White

All painted USA markings shall be removed by the permittee after the work has been completed.

11. Wheelchair ramps shown on Drawing No. R-64 or R-65 shall be constructed where any portion of the curb, at a legal pedestrian crosswalk or any portion of the sidewalk in immediate contact with such curb is removed, except where there is an existing wheelchair ramp in the cross-walk or where there is a subsidewalk basement behind the crosswalk.
12. All damaged pavement markings and striping shall be replaced and restored by the excavator.

100-1.07 Defects

1. Depressed trench pavement shall be repaired as follows:
 - A. Wearing surface defects - remove and restore wearing surface.
 - B. Major defects - excavate, remove and restore surface and base.
 - C. The Permit Inspector will determine the severity of the defect.
2. Work not complying with the above requirements shall be rejected, removed, and redone to the satisfaction of the City Engineer.
3. The owner of the facility/utility company is responsible for the roadway defects appearing after the permittee restores the trench (area adjacent to the trench). The owner is responsible for maintenance, repair or reconstruction of the excavation site's affected area until the city reconstructs, repaves, or resurfaces the street.
4. If there is a trench related failure after the work by the city, the owner of the facility/utility company is responsible for its repair.

5. The owner of the facility/utility company is responsible to maintain the trenches and repair any defects that may appear. The City Engineer will determine who is responsible for a defect when one is detected and will notify the responsible party and direct them to repair the facility.

When the City determines that an excavation or a defect is hazardous or constitutes a public nuisance or other imminent threat to public health, safety, or welfare, the City Engineer may order the responsible party to remedy the condition immediately.

- A. If the responsible party refuses or fails to make the needed repairs immediately, the City will make the repairs and:
 - 1) The responsible party will be charged all the actual costs including administration, construction, consultant fees, equipment, inspection, notification, remediation made necessary by the action of the permittee, repair, and restoration.
 - 2) The repair or restoration by the City does not relieve the responsible party from liability for future pavement failures.
 - 3) If the responsible party fails or refuses to pay the restoration cost, the cost of the repair or restoration will be deducted from the responsible party's deposit.

6. If the owner/person responsible for the roadway defect does not make the required repairs, the City will make the repairs and the responsible party will be charged for all the actual cost of repair, including but not limited to administration, construction, consultant fees, equipment, inspection, notification, remediation made necessary by the action of the permittee, and restoration. Repairs or restoration by the City does not relieve the responsible party(s) from liability for future pavement failures. If the responsible party fails or refuses to pay the cost of the repair, the cost will be deducted from the responsible party's deposit.

100-1.08 Violations

100-1.08.1 Excavation Violations - Any violation of the above regulations may result in the revocation of the encroachment permit and/or be subject to a citation process and/or fine. The fines for various violations are as follows:

VIOLATIONS	PENALTY (Not to exceed amount shown)
1. Working without a Permit(s), control number not called in.	\$1,000 and Stop Work

VIOLATIONS	PENALTY (Not to exceed amount shown)
2. Excavation without providing Public Notice	\$1,000 and Stop Work
3. Beginning a "Major Project" without having a Pre-Construction Meeting	\$500 per occurrence, per day
4. Violation of Permit Conditions	\$500 per occurrence, per day
5. Improper Site Protection: Improper plating, path of travel, barricading, etc.	\$500 per occurrence, per day
6. No permit on site	\$250 per occurrence, per day
7. Improper Trimming of Trench	\$250 per Trench
8. Any trench left open after the allowed work hours that is not back filled and covered.	\$250 per day
9. Improper Public Notice: No Project Sign, wrong information on sign/notice	\$100 per block, per day
10. Non-compliance with Trench Restoration Requirements	\$250 per trench, per day
11. Improper Housekeeping: Failure to remove spoil, dirty site, no sweeping, etc.	\$100 per block, per day
12. Other Excavation Code Violations	\$100 per occurrence, per day
13. Call for Inspection but not ready to be inspected	\$250 per occurrence, per day

The above fines, when assessed, shall be deducted from the cash deposit required by 100-1.03 5A of this section or will be paid by the applicant if there is not a cash deposit.

To appeal any citations, fines, or other requirements, the Stockton Municipal Code procedure for appeal shall be followed. If there are any fines they must be paid and will be reimbursed if the

appeal is valid.

100-1.08.2 Other Violations - Any violation of the above regulations and/or Chapter 9 of the Stockton Municipal Code may result in the revocation of the encroachment permit and/or be subject to an administrative citation.

Violations include but are not limited to working without a permit, failure to obtain a control number before starting work, no permit on the work site, failure to comply with the permit's conditions, provisions and requirements, improper work area housekeeping, and work left open after allowed work hours that is not filled/covered.

SPECIAL PROVISIONS
FOR
MARIPOSA ROAD AT
MARIPOSA INDUSTRIAL PARK
TRAFFIC SIGNAL INSTALLATION

City of Stockton

November, 2022

The special provisions contained herein have been prepared by or under the direction of the following Registered Persons.



REGISTERED CIVIL ENGINEER



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DIVISION I GENERAL PROVISIONS

SECTION 1 - SPECIFICATIONS AND PLANS

1-1.01 Specifications

The work described herein shall be done in accordance with the current City of Stockton, Department of Public Works Standard Specifications and Plans, and the latest Editions of the State of California, Department of Transportation Standard Specifications and Standard Plans, California MUTCD, as referenced therein, and in accordance with the following Special Provisions. To the extent the California Department of Transportation Standard Specifications implement the STATE CONTRACT ACT, (or certain provisions of the Public Contracts code which are inapplicable to charter cities) they shall not be applicable.

In case of conflict or discrepancy between any of the Contract Documents, the order of documents listed below shall be the order of precedence, with the first item listed having the highest precedence.

1. Contract Change Order (changes last in time are first in precedence)
2. Addenda to Contract Agreement
3. Contract Agreement
4. Permits
5. Notice Inviting Bids and Instructions to Bidders
6. Addendums and Letters of Clarification
7. Special Provisions
8. Project Drawings
9. City of Stockton Standard Specifications
10. City of Stockton Standard Drawings
11. Caltrans Standard Specifications
12. Caltrans Standard Plans

Should it appear that the work to be done or any of the matters relative thereto are not sufficiently detailed or explained in these specifications, the special provisions, or the plans, the contractor shall apply to the Engineer in writing for such further explanations as may be necessary and shall conform to them as part of the contract. In the event of any doubt or question arising respecting the true meaning of these specifications, the special provisions or the plans, reference shall be made to the Engineer, whose decision thereon shall be final.

1-1.02 Plans

Attention is directed to the provisions in Section 1-1.03 "Definitions", of the Standard Specifications and Section 1-1.07 "Definitions", of the Caltrans Specifications.

1-1.03 Terms and Definitions

Wherever in the Standard Specifications, Special Provisions, Notice to Contractors, Proposal, Contract, or other contract documents the following terms are used, the intent and meaning shall be interpreted as follows:

SP3

City or Owner -	City of Stockton
Director -	Director of Public Works, City of Stockton
Standard Specifications -	Current City of Stockton, Standard Plans and Specifications, inclusive of all current revisions, and amendments, unless otherwise stated.
Caltrans Specifications -	State of California, Department of Transportation, Current Standard Plans and Specifications, inclusive of all current revisions, and amendments, unless otherwise stated.
Laboratory -	City of Stockton Department of Public Works Laboratory or consultant's laboratory
Department -	Department of Public Works, City of Stockton
Engineer -	City Engineer, City of Stockton, acting either directly or through properly authorized Engineer agents and consultants
California MUTCD	Latest edition of California Manual on Uniform Traffic Control Devices (MUTCD), and any amendments and revisions thereto.
Working Day	Defined as any eight-hour day, except as follows: Saturday, Sunday, and City recognized holidays.

SECTION 2 – Blank

SECTION 3 – Blank

SECTION 4 – SCOPE OF WORK

Attention is directed to the provisions in Section 4, “Scope of Work” of the Caltrans Specifications, Standard Specification, and these Special Provisions.

The Contractor shall follow the sequence of construction and progress of work as specified in Section 10-1.01, "Order of Work", of these Special Provisions.

The Contractor shall diligently prosecute all work items to completion.

Full compensation for any additional costs occasioned by compliance with the provisions in this section shall be considered as included in the prices paid for the various contract items of work, and no additional work compensation will be allowed therefore.

Bidders will be required to carefully examine these special provisions and attachments to judge for themselves as to the nature of the work to be done and the general conditions relative thereto and the submission of a proposal hereunder shall be considered prima-facie evidence that the bidder has made the necessary investigation and is satisfied with respect to the conditions to be encountered, the character, quantity and quality of the work performed. For work to be completed, contractors are advised to visit and review the job site prior to the submission of their bid.

Bidders must be thoroughly competent and capable of satisfactorily performing the work covered by the proposal, and when requested shall furnish such statements relative to previous experience on similar work, the plan or procedure proposed, and the organization and the equipment available for the contemplated work, and any other as may be deemed necessary by the City Engineer in determining such competence and capability.

It shall be understood that the Contractor shall be required to perform and complete the proposed work in a thorough and diligent manner, and to furnish and provide in connection therewith all necessary labor, tools, implements, equipment, materials and supplies. The Contractor is responsible to take all necessary precautions and use best practices in the industry to perform all work require completing the project.

4-1.01 Differing Site Conditions

Attention is directed to the provisions in Section 4-1.06, "Differing Site Conditions," of the Caltrans Specifications and the Standard Specifications. Contractor shall notify the Engineer if he/she finds physical conditions differing materially from contract documents.

SECTION 5 – CONTROL OF WORK

Attention is directed to the Instruction to Bidders, provisions in Section 5 "Control Work" of the Caltrans Specifications, Standard Specification and these special provisions.

5-1.01 Contract Components

Attention is directed to the provisions in Section 5-1.02,"Contract Components" of the Standard Specifications. If a discrepancy found or confusion arises, submit a Request for Information (RFI).

5-1.02 Subcontracting

Attention is directed to the provisions in Section 5-1.13A, "Subcontracting," of the Standard Specifications, and Caltrans Specifications.

5-1.04 Coordination With Other Entities

5-1.04A Permits

The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work. The Environmental Quality Act (Public Resources Code, Sections 21000 to 21176, inclusive) may be applicable to permits, licenses and other authorizations which the Contractor must

obtain from local agencies in connection with performing the work of the contract. The Contractor shall comply with the provisions of those statutes in obtaining the permits, licenses and other authorizations and they shall be obtained in sufficient time to prevent delays to the work. In the event that the City has obtained permits, licenses or other authorizations, applicable to the work, in conformance with the requirements in the Environmental Quality Act, the Contractor shall comply with the provisions of those permits, licenses and other authorizations. The following is a non-inclusive list of the required permits and/or licenses:

- Contractor's License. At a minimum the Contractor shall possess at the time of bid and maintain throughout the duration of the contract, a valid California Class A or C-10 Contractor License.
- Business License. Contractor shall possess prior to the execution of the contract and maintain throughout the duration of the contract, a valid City of Stockton business license.
- City of Stockton and San Joaquin County Encroachment Permit
- Stockton Municipal Utilities Department Right-of-Entry Permit
- State's Water Resources Control Board Stormwater Construction General Permit
 - Storm Water Pollution Prevention Plan
 - Notice of Intent (NOI)
 - Notice of Termination (NOT)
 - County Encroachment Permit

5-1.05 Submittals

The following is a list of anticipated submittals for the project. The list is provided to aid the Contractor in determining the scope of work, but is not intended to be all inclusive and additional submittals may be required:

- 1) Baseline Progress Schedule (Critical Path Method)
- 2) Storm water Pollution Prevention Plan
- 3) Approved Notice of Intent from State Water Resources Control Board
- 4) Pre-construction survey
- 5) Temporary Traffic Control (includes Pedestrian Detour Plan)
- 6) Contractor Safety Plan
- 7) Portland Cement Concrete Mix Design
- 8) Staging Agreement with private property owners (if applicable)
- 9) City of Stockton and San Joaquin County Encroachment Permit
- 10) City's Construction and Demolition Debris Recycling Report
- 11) List of submittals
- 12) Product submittals
- 13) Lead Compliance Plan—if applicable
- 14) A Schedule of Values

The Contractor shall transmit each submittal to the Engineer for review and approval with

the submittal form approved by the Engineer. Submittals shall be sequentially numbered on the submittal form. Resubmittals shall be identified with the original number and a sequential resubmittal suffix letter. The original submittal shall be numbered X. The first resubmittal shall be numbered X-a and so on. Identify on the form the date of the submittal, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and/or special provision number, as appropriate. The Contractor shall sign the form certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and contract documents. Any incomplete submittals will be returned for resubmittal.

Schedule submittals to expedite the Project, and deliver to Engineer at the Engineer's office, see Section 10-1.01, "Order of Work," of these Special Provisions.

For each submittal for review, allow 15 calendar days excluding delivery time to and from the Contractor.

Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

When revised for resubmission, identify all changes made since previous submission.

Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

Submittals not requested either in the Contract Documents or in writing from the Engineer will not be recognized or processed.

When required by the Engineer, the Contractor shall furnish to the Engineer for review, 1 set, plus one reproducible copy, of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state of California, unless otherwise directed.

Normally, a separate submittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multi-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.

Except as may otherwise be indicated herein, the Engineer will return prints of each submittal to the Contractor with their comments noted on the submittal. The Contractor shall make complete and acceptable submittals to the Engineer by the second submission

of a submittal item.

If a submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN", formal revision and resubmission of said submittal will not be required.

If a submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED", formal revision and resubmission of said submittal will not be required.

5-1.06 Job Site Appearance

Attention is directed to Section 4-1.13 "Cleanup" of the Caltrans Specifications, Section 5-1.31 "Job Site Appearance" of the Standard Specifications, and these Special Provisions.

The Contractor shall maintain a neat appearance to the work.

Broken concrete and debris developed during clearing and grubbing shall be disposed of concurrently with its removal. Contractor shall pay to the City of Stockton the sum of Two Hundred Fifty Dollars (\$250) for every calendar day where debris has remained on the job site overnight.

Full compensation for conforming to the provisions in this section shall be considered as included in the prices paid for the various contract items of work involved, and no additional compensation will be allowed therefore.

5-1.07 Staging Area

Attention is directed to Section 5-1.36E, "Use of Private property," of the Standard Specification and these Special Provisions. The street right-of-way shall be used only for activities that are necessary to perform the required work. The Contractor shall not occupy the right-of-way or allow others to occupy the right-of-way for material storage or other purposes that are not necessary to perform the required work.

5-1.08 Construction Staking

Section 5-1.26, "Construction Surveys", of the Standard Specifications is deleted, and replaced with the following:

1. The Contractor shall be responsible for all construction survey stakes necessary to construct the project in accordance to the lines, grades, sections, stage construction/traffic handling, and traffic signalization, pavement delineation plan described in the plans and specifications.
2. Contractor shall be responsible referencing all existing monumentation within the limits of the project prior to removal of any existing monuments. Monument referencing shall be reviewed and approved by the engineer prior to commencing of the work.
3. The Contractor shall employ a Land Surveyor registered in the State of California or an appropriately registered Civil Engineer to perform such survey

work. All stakes and marks set by the Contractor's Land Surveyor or Civil Engineer shall be carefully preserved by the Contractor. In case such stakes and marks are destroyed or damaged, they will be promptly replaced, at the direction of the Engineer at no additional cost to the City. Copies of all field notes and cut sheets shall be provided to the City at no additional cost to the City.

Full compensation for conforming to the provisions in this section shall be considered as included in prices paid for the various contract items of work involved, and no additional compensation will be allowed therefore.

5-1.9 Increased or Decreased Quantities

The City reserves the right to make such alterations, deviations, additions to, or omissions from the plans and specifications, including the right to increase or decrease the quantity of any item or portion of the work or to omit any item or portion of the work, as may be deemed by the Engineer to be necessary or advisable and to require such extra work as may be determined by the Engineer to be required for the proper completion or construction of the whole work contemplated, without adjustment in the unit price as bid.

5-1.10 Blank

5-1.11 Rights in Land

All work, equipment parking, or any other activity associated with the project shall be confined to the project limits within the street rights-of-way. The Contractor's use of any other property exclusively in connection with this project shall be by a written agreement between the property owner and the Contractor. A certified copy of any such agreement shall be furnished to the Engineer prior to the use of such property by the Contractor.

5-1.12 As-Built/Record Drawings

The Contractor shall maintain a complete set of drawings on-site for the purpose of keeping up to date all field modifications. This plan set shall be available for review by the project Inspector and the Engineer. These plans shall be provided to the Inspector after the completion of construction at the Post-Construction Meeting and prior to the final payment. All revisions, modifications, and/or changes shall be marked clearly. Notes and dimensions shall be in red and be clear and legible. These plans will be used by the Engineer to mark up the original plan sheets with the revisions made during construction.

5-1.13 Property and Facility Preservation

Attention is directed to Section 5-1.36, "Property and Facility Preservation," of Caltrans Specifications and these Special Provisions. Due care shall be exercised to avoid injury to existing highway improvements or facilities, utility facilities, adjacent property, and roadside trees shrubs and other plants that are not to be removed. Roadside trees, shrubs and other plants that are not to be removed, and pole lines, fences, signs, markers and monuments, buildings and structures, conduits, pipelines under or above ground, sewer and water lines, all highway facilities and any other improvements or facilities within or adjacent to the highway shall be protected from injury or damage, and if ordered by the

Engineer, the Contractor shall provide and install suitable safeguards, approved by the Engineer, to protect the objects from injury or damage. If the objects are injured or damaged by reason of the Contractor's operations, the objects shall be replaced or restored at the Contractor's expense.

The facilities shall be replaced or restored to a condition as good as when the Contractor entered upon the work, or as good as required by the specifications accompanying the contract, if any of the objects are a part of the work being performed under the contract. The Engineer may make or cause to be made those temporary repairs that are necessary to restore to service any damaged highway facility. The cost of the repairs shall be borne by the Contractor and may be deducted from any moneys due or to become due to the Contractor under the contract. The fact that any underground facility is not shown upon the plans shall not relieve the Contractor of the responsibility under this Section of these Special Provisions. It shall be the Contractor's responsibility, pursuant thereto, to ascertain the location of those underground improvements or facilities which may be subject to damage by reason of the Contractor's operations.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in protecting or repairing property as specified in this Section shall be considered as included in the prices paid for the various contract items of work and no additional compensation will be allowed therefor.

5-1.14 Pre-construction Survey

Attention is directed to Section 5-1.36D, "Survey Monuments" of the Caltrans Specifications and these Special Provisions. The Contractor shall perform a pre-construction survey of all existing structures, pavements, and other aboveground facilities within the project limits prior to beginning any work, noting their condition by means of photographs and video tapes supplemented by written documentation, where applicable.

Color photographs shall be taken with a digital camera at locations that are appropriate to show pre-existing conditions. Each photograph shall show the date and time the photograph was taken and clearly labeled showing the location, viewing direction, and any special features noted. Digital files of each photograph and a copy of videotapes shall be submitted to the Engineer.

Preserving and Perpetuating Survey Monuments

The contractor shall exercise due caution and shall carefully preserve bench marks, control points, reference points and all survey monuments, and shall bear all expenses for replacement and/or error caused by his/her unnecessary loss or disturbance. The contractor shall consult with a licensed land surveyor or civil engineer licensed to practice land surveying in California prior to beginning construction to ensure that any preconstruction corner records, as required by the State of California Professional Land Surveyor' ACT have been filed with the County Surveyor, pursuant to Section 8771(a-f) of the California Business and Profession Code.

Action by:	Action:
<i>Contractor's Land Surveyor</i>	<ol style="list-style-type: none"> 1. Identifies existing survey monuments. 2. Lists all existing survey monuments. 3. Ties out / performs construction staking of survey monuments. 4. Indicates survey monuments on construction plans. 5. Files all pre-construction Corner Records or Records of Survey with San Joaquin County. The Corner Records or Record of Survey will show monuments within the area of construction reasonably subject to removal or disturbance not shown on a recent record document (recent record document is a filed survey map or corner record document completed with acceptable modern survey methods that includes survey ties from monuments within the construction area to monuments outside of the construction area). 6. Submits copies of pre-construction Corner Records or Records of Survey filed with San Joaquin County to City Engineer/Project Manager
<i>Contractor</i>	<ol style="list-style-type: none"> 7. Preserves/perpetuates all survey monumentation during construction, including, but not limited to, those listed. 8. Restores survey monuments disturbed by construction.
<i>Contractor's Land Surveyor,</i>	<ol style="list-style-type: none"> 9. Files all post-construction Corner Records and Records of Survey with San Joaquin County for all monuments disturbed during construction 10. Submits copies of Corner Records or Records of Survey filed with San Joaquin County to City Engineer/Project Manager.

Monuments set shall be sufficient in number and durability and efficiently placed so as not to be readily disturbed, to assure, together with monuments already existing, the perpetuation or facile reestablishment of any point or line of the survey.

When monuments exist that control the location of subdivisions, tracts, boundaries, roads, streets, or highways, or provide horizontal or vertical survey control, the monuments shall be located and referenced by or under the direction of a licensed land surveyor or registered civil engineer prior to the time when any streets, highways, other rights-of-way, or easements are improved, constructed, reconstructed, maintained, resurfaced, or relocated, and a corner record or record of survey of the references shall be filed with the county surveyor. They shall be reset in the surface of the new construction, a suitable monument box placed thereon, or permanent witness monuments set to perpetuate their location if any monument could be destroyed, damaged, covered, or otherwise

obliterated, and a corner record or record of survey filed with the county surveyor prior to the recording of a certificate of completion for the project. Sufficient controlling monuments shall be retained or replaced in their original positions to enable property, right-of-way and easement lines, property corners, and subdivision and tract boundaries to be reestablished without devious surveys necessarily originating on monuments differing from those that currently control the area. It shall be the responsibility of the governmental agency or others performing construction work to provide for the monumentation required by this section. It shall be the duty of every land surveyor or civil engineer to cooperate with the governmental agency in matters of maps, field notes, and other pertinent records. Monuments set to mark the limiting lines of highways, roads, streets or right-of-way or easement lines shall not be deemed adequate for this purpose unless specifically noted on the corner record or record of survey of the improvement works with direct ties in bearing or azimuth and distance between these and other monuments of record.

The decision to file either the required corner record or a record of survey pursuant to subdivision shall be at the election of the licensed land surveyor or registered civil engineer submitting the document.

5-1.15 Cooperation

Should construction be under way by other forces or by other contractors within or adjacent to the limits of the work specified or should work of any other nature be under way by other forces within or adjacent to those limits, the Contractor shall cooperate with all the other contractors or other forces to the end that any delay or hindrance to their work will be avoided. The right is reserved to perform other or additional work at or near the site (including material sources) at any time, by the use of other forces. When 2 or more contractors are employed on related or adjacent work, or obtain materials from the same material source, as provided in Section 6, "Control of Materials" of the Caltrans Specifications, each shall conduct their operations in such a manner as not to cause any unnecessary delay or hindrance to the other. Each contractor shall be responsible to the other for all damage to work, to persons or property caused to the other by their operations, and for loss caused the other due to unnecessary delays or failure to finish the work within the time specified for completion.

The Contractor shall protect from damage any utility facilities that are to remain in place, be installed, relocated, adjusted, or otherwise rearranged.

The Contractor should note that the following utility companies and other agencies maintain facilities within the project area and may have forces in the project area or adjacent thereto:

- PG&E
- AT&T and other phone companies
- City of Stockton Municipal Utilities Department
- Comcast Cable Company
- California Water Service Company

The Contractor shall verify the horizontal and vertical locations of all existing utilities prior to start of construction. The Contractor shall be responsible for the repair and replacement of these or any other facilities damaged during construction. A minimum of forty-eight (48) hours or two (2) working days prior to beginning construction, the Contractor shall notify Underground Services Alert (USA), telephone (800) 227-2600, to have existing facilities marked in the field.

Installation and/or relocation of the aforementioned utilities and other agencies' facilities will require coordination with the Contractor's operations. The Contractor shall make necessary arrangements with the utility company and other agencies through the Engineer, and shall submit a schedule of work, verified by a representative of the utility company or other agency, to the Engineer. The Contractor shall notify the Engineer in writing one (1) month and again one (1) week prior to preparing the site for the utility relocation work or work to be done by other agencies.

The Contractor shall take care to avoid working in any area of the project, which may conflict with the work underway by the utility companies. The Contractor's construction schedule shall be prepared to avoid utility work.

The Contractor shall cooperate completely with all utility companies having facilities within the project area.

Attention is directed to the possible existence of underground facilities not known to the City or in a location different from that which is shown on the plans or in these Special Provisions. The Contractor shall take steps to ascertain the exact location of all underground facilities prior to doing work that may damage such facilities or interfere with their service.

Payment for complying with this Special Provision shall be included in the various items of work, and no additional compensation will be allowed therefore.

SECTION 6 – CONTROL OF MATERIALS

Attention is directed to the provisions in Section 6, "Control of Materials," of the Standard Specifications, and these Special Provisions.

6-1.01 Testing

Testing of materials and work shall conform to the provisions in Section 6, "Control of Materials" of the Caltrans Specifications and these special provisions. Whenever the provisions of Section 6 of the Caltrans Standard Specifications refer to tests or testing, it shall mean tests to assure the quality and to determine the acceptability of the materials and work.

6-1.02 Pre-qualified and Tested Signing and Delineation Material

The California Department of Transportation maintains the list of Prequalified and Tested signing and delineation materials and products. Approval of pre-qualified and tested products and materials shall not preclude the Engineer from sampling and testing any of

the signing and delineation materials or products at any time.

None of the listed signing and delineation materials and products shall be used in the work unless such material or product is listed on the California Department of Transportation's List of Approved Traffic Products. A Certificate of Compliance shall be furnished as specified in Section 6, "Control of Materials", of the Caltrans Specifications for signing and delineation materials and products. Said certificate shall also certify that the signing and delineation material or product conforms to the pre-qualified testing and approval of the California Department of Transportation, Division of Traffic Operations, and was manufactured in accordance with the approved quality control program.

For those categories of materials included on the list of Prequalified and Tested Signing and Delineation Materials, only those products shown within the listing may be used in the work. Other categories of products, not included on the list of Prequalified and Tested Signing and Delineation Materials, may be used in the work provided they conform to the requirements of the Standard Specifications. The list of approved pre-qualified and tested signing and delineation materials and products can be found at the California Department of Transportation Web Site:

<https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/mets/signing-and-delineation-materials-a11y.pdf>

SECTION 7 – LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

7-1.01 General

Attention is directed to Section 7 “Legal Relations and Responsibility to the Public” of the Caltrans Specifications, Standard Specifications, and these Special Provisions.

7-1.02 Maintaining Public Convenience and Safety

Attention is directed to Sections 7-1.03, "Public Convenience", 7-1.04, "Public Safety", and Section 12, "Temporary Traffic Control", of the Caltrans Specifications. Attention is also directed to Part 6 of the California MUTCD and Sections 7-1.03, "Public Convenience", 7-1.04, "Public Safety", of Standard Specifications, and Section 12-1.01, “Maintaining Traffic” of these Special Provisions. Nothing in these Special Provisions shall be construed as relieving the Contractor from his responsibility as provided in said sections and Part 6 of the California MUTCD.

7-1.03 Trench Safety

Attention is directed to Sections 7-1.02K(6)(b), "Excavation Safety” of the Standard Specifications and these Special Provisions.

If required, the Contractor shall furnish all labor, equipment, and materials required to design, construct, and remove all shoring, lagging, cribbing, piling, and/or other types of support for the wall of any open excavation required for the construction of this project.

In making excavations for the project, the Contractor shall be fully responsible for providing and installing adequate sheeting, shoring, and bracing, as may be necessary as a precaution against slides or cave-ins and to fully protect all existing improvements of any kind from damage.

The Contractor shall be solely responsible for any damages which may result from his failure to provide adequate shoring to support the excavations under any or all of the conditions of loading which may exist or which may arise during the construction project. Nothing herein shall be deemed to allow the use of shoring, sloping, or protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety.

7-1.04 Public Convenience

Contractor's attention is directed to the Section 12-1.01 "Maintaining Traffic" of these Special Provisions, Section 7-1.03 "Public Convenience" of the Standard Specifications, and these Special Provisions.

The Contractor shall notify San Joaquin Regional Transit District (SJRTD) a minimum of five (5) working days prior to beginning work. The Contractor shall coordinate with SJRTD if any bus stops and bus routes are affected.

The Contractor shall inform the City Fire Department, City Police Department, Public Works Traffic Engineering, Municipal Utilities Department (MUD), and all affected utilities no later than three (3) working days before work is to begin.

The Contractor shall provide the City with the name and telephone number (business, home and mobile) of three (3) representatives available at all times during the duration of the contract. Said names and telephone numbers shall be provided to the City of Stockton Public Works, Fire, and Police Departments.

The Contractor shall circulate printed form letters, approved by the Engineer, explaining the project to be done and the length of time inconvenience will be caused by the project and deliver same to the residents and businesses to be affected at least three (3) working days before work is to commence on their street. In addition, the Contractor shall provide temporary "No Parking" signs posted three (3) working days in advance of the work. Such signs shall be placed no further than fifty (50) feet apart. The additional "No Parking" signs shall be removed upon completion of the work and the opening of the street to traffic. It shall be the Contractor's responsibility to remove any vehicles obstructing his operations.

7-1.05 Public Safety

Contractor's attention is directed to the Section 12-1.01 "Maintaining Traffic" of these Special Provisions, Section 7-1.04 "Public Safety" of the Standard Specifications, and these Special Provisions. Nothing in the specifications voids the contractor's public safety responsibilities.

All safety devices, their maintenance, and use shall conform to the latest requirements of

OSHA and shall conform to the applicable provisions of the Part 6 "Temporary Traffic Control", of the **California MUTCD**. It shall be the complete responsibility of the Contractor to protect persons from injury and to avoid property damage. Adequate barricades, construction signs, flashers, and other such safety devices, as required, shall be placed and maintained during the progress of the construction work, until the project is completed. Whenever required, flaggers shall be provided to control traffic.

The Contractor shall provide for the proper routing of vehicles and pedestrian traffic in a manner that will hold congestion and delay of such traffic to practicable minimum by furnishing, installing, and maintaining all necessary temporary signs, barricades, and other devices and facilities, as approved by the City Traffic Engineer. As the work progresses, the Contractor shall relocate, subject to the City Traffic Engineer's approval, such devices and facilities as necessary to maintain proper routing. The Contractor shall notify the City Traffic Engineer a minimum of three (3) working days prior to the relocation of any traffic control devices.

When work is not in progress on a trench or other excavation that requires closure of an adjacent lane, the traffic cones or portable delineators used for the lane closure shall be placed off of and adjacent to the edge of the traveled way. The spacing of the cones or delineators shall be not more than the spacing used for the lane closure.

7-1.06 Indemnification and Insurance

Attention is directed to Section 7-1.05 "Indemnification" and Section 7-1.06, "Insurance" of the Standard Specifications.

SECTION 8 – PROSECUTION AND PROGRESS

Attention is directed to the provisions in Section 8 of the Standard Specifications, and these Special Provisions.

8-1.01 Time of Completion

Attention is directed to the provisions in Sections 8-1.05A, "Time", and 8-1.07, "Delay" of the Standard Specifications, and these Special Provisions.

Submittals shall be delivered to the Engineer within thirty (30) calendar days of execution of contract. Contract shall not start any work on the job site until the Engineer approves the submittals. Refer to section 5-1.05, "Submittals" of these Special Provisions. The Contractor shall only enter the jobsite prior to approval of the above submittals for purposes of measuring field dimensions and locating utilities.

Prior to Notice to Proceed, the Contractor shall indicate in writing when all the traffic signal hardware and equipment, which makes the traffic signal and communication system operational, will be delivered to the project site.

SECTION 9 – PAYMENT

9-1.01 Description of Work

The work to be performed consists of furnishing all labor, materials, tools, transportation,
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supplies, equipment, appurtenances, fuel, and power, unless specifically excepted, necessary, or required to install the traffic signal system, as further delineated on the plans and described in these Special Provisions.

The work shall include, but not be limited to, the following:

1. Mobilization
 - a. All costs connected with mobilization of Contractor's operations as and preparatory work.

2. Traffic Control System
 - a. Includes all labor, materials to provide in accordance with Section 12, "Temporary Traffic Control" of the Caltrans Specifications. Includes designing, furnishing, installing and maintaining traffic control as indicated on the plans and described in these Special Provisions. Also includes flagging costs, materials (including signs, cones, project information signs, portable delineators, portable changeable message signs, flashing arrows, and barricades and all other items shown on the traffic handling plans for which there is not a contract item in the estimate), tools, equipment, and incidentals (including overhead lighting, cellular phones and radios), and for doing all the work involved in placing, removing, storing, maintaining, moving to new locations, replacing and disposing of the components of the traffic control system shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer, including, but not limited to, temporary pavement markings (paint), temporary markers, temporary traffic striping (paint), and channelizers (surface mounted).

3. Traffic Signal and Electrical
 - a. Includes furnishing all labor, materials, tools, equipment and incidentals for all the work involved in, but not limited to, trenching and installing conduit, jacking and boring and installing conduit, installing conductors, controller cabinet equipment, signal standards, service equipment enclosure, pull boxes, detection loops, traffic signal poles, vehicular and pedestrian heads and framework, pedestrian push buttons, signs mounted on traffic signal poles, safety lighting, concrete controller pad, concrete foundations, emergency vehicle preemption system, closed circuit television camera, video detection, Ethernet switch, video and data field and central modems, encoder and ancillary video and data digital networking equipment, interconnect conduit, fiber optic cable, splice enclosures, testing fiber system, all fiber connections, modifying irrigation and landscaping to accommodate installation of traffic signal equipment, removing street lights, start-up and testing.

ITEM NO.	ITEM DESCRIPTION	UNITS	ESTIMATED QUANTITY
1	MOBILIZATION	LS	1
2	TRAFFIC CONTROL SYSTEM	LS	1
3	TRAFFIC SIGNAL AND ELECTRICAL	LS	1

DIVISION II GENERAL CONSTRUCTION

SECTION 10 – GENERAL CONSTRUCTION

10-1.01 Order of Work

Contractor's attention is directed to the Public Safety, Public Convenience, and Maintaining Traffic sections of these Special Provisions. Nothing in this section shall be construed as to relieve the Contractor of his/her responsibility to stage the work in a manner which complies with the requirements of these sections.

All permits and approvals as may be required for this project shall be secured by the Contractor.

The Contractor shall stage and sequence the work as follows:

1. The contractor orders all items required, after all submittals are approved by the Engineer, for this project which may have long lead times to assure that their acquisition is not the cause for any delays. These items may include, but are not limited to, traffic signal equipment, street lighting, and related appurtenances. The Contractor shall furnish the Engineer with statements from the vendors that the orders for said equipment has been received and accepted by said vendors. These statements shall be furnished within ten (10) working days of the Notice to Proceed date.
2. Obtain all necessary permits from City of Stockton and San Joaquin County.
3. Prior to the start of construction, the Contractor shall submit to the Engineer for approval a detailed "Traffic Control Plan" which also addresses pedestrian detours. The Traffic Control Plan shall be prepared in accordance with the provisions in Section 12-1.01," Maintaining Traffic" of these special provisions.
4. Traffic signal and lighting standards and other above ground electrical equipment shall not be installed until the Contractor has received delivery of all electrical materials.
5. Prior to the start of construction, the Contractor shall verify the location and

depth of all existing utilities and underground facilities within the project limits. The Contractor shall notify the Engineer of any discrepancies between the conditions in the field and the plans.

6. Street lighting, traffic signals, including fiber system shall be maintained at all times.
7. The Contractor shall develop and implement a Storm Water Pollution Prevention Plan (SWPPP), which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters. The Contractor shall inspect and maintain all BMPs.
8. Portions of existing concrete curbs, gutters and sidewalks that are removed shall be replaced within 10 working days after removal.

At the end of each working day if a difference in excess of 2 inches exists between the elevation of the existing pavement and the elevation of excavations within 4 feet of the traveled way, material shall be placed and compacted against the vertical cuts adjacent to the traveled way. During excavation operations, native material may be used for this purpose; however, once placing of the topsoil commences, topsoil material shall be used. The material shall be placed to the level of the elevation of the top of existing pavement and tapered at a slope of 1:4 (vertical:horizontal) or flatter to the bottom of the excavation.

Minor deviations from these requirements may be allowed by the Engineer, if in the opinion of the Engineer, the prosecution of the contract will be better served and the work expedited. Any Contractor request for such deviations shall not be adopted without the Engineer's prior written approval.

10-1.02 Alternative Equipment

The City reserves the right to order discontinuance of any equipment in use. This will be determined at the discretion of the Engineer on the basis that the use of said equipment would prohibit obtaining the best possible end result.

Additional installation equipment may be requested by the Engineer for the above reason. Failure to comply with the Engineer's request concerning equipment use or removal will be deemed sufficient cause for shutting down all work until the requirements are met. Days lost for this type of shutdown will be charged as working days.

10-1.03 Inspections

All work under this contract shall be under the control and inspection of the City Engineer or his appointed representative. The Contractor shall notify of the Public Works Department, at (209) 937-8381, three (3) working days in advance of any construction.

10-1.04 Obstructions

Attention is directed to Section 5-1.36, "Property and Facility Preservation" of Caltrans

Specifications, Sections 7-1.05, "Indemnification" and Section 7-1.06, "Insurance", of the Standard Specifications and Section 15, "Existing Facilities", of the Caltrans Specifications and these Special Provisions.

The Contractor's attention is directed to the existence of certain underground facilities that may require special precautions be taken by the Contractor to protect the health, safety, and welfare of workers and of the public. Facilities requiring special precautions include, but are not limited to, conductors of petroleum products, oxygen, chlorine, and toxic or flammable gases, natural gas in pipelines six (6) inches or greater in diameter, or pipelines operating at pressures greater than 415 KPa (gage); underground electric supply system conductors or cables with potential to ground of more than 300 V, either directly buried or in duct or conduit, which do not have concentric grounded or other effectively grounded metal shields on sheaths.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least two (2) working days, but not more than fourteen (14) calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire, or other structure. Regional notification centers include, but are not limited to, the following:

Notification Center	Telephone Number
Underground Service Alert – Northern California (USA)	(811) 227-2600 (800) 227-2600
South Shore Utility Coordinating Council (DICS)	(800)-541-3447

Relocations or repairs necessitated because of existing facilities, which are not shown on the plans or are shown at substantially different locations than existing, may be paid as extra work in accordance with Section 4-1.02, "Changes and Extra Work", of the these Special Provisions, but only if the Engineer rules that the Contractor exercised due diligence in his operation. Due diligence may be determined by the Engineer by reviewing surface and subsurface conditions that were existing prior to exposing the facility and determining the absence of any signs sufficient to warn a diligent Contractor of the possible existence of a facility in the area.

Immediately upon encountering unknown existing facilities, the Contractor shall notify the Engineer in writing of the situation, request coverage of the work as extra work, and aid the Engineer in determining due diligence. Failure to do so may result in forfeiture of any rights to receive extra work compensation under Section 8-1.07, "Delay", of the Standard Specifications. Should the Contractor stop work, no compensation will be made for any "down time" prior to written notifications being received by the Engineer or his representative.

Payment for complying with this Special Provision shall be included in the various items of work, and no additional compensation will be allowed therefore.

10-1.05 System Outage Request, City of Stockton Facilities

Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of treatment processes, equipment, utilities, or other facilities. In addition to the Construction Schedule required under these Special Provisions, the Contractor shall submit a System Outage Request (SOR) and a detailed outage plan and time schedule for all construction activities, which will make it necessary to remove a tank, pipeline, channel, electrical circuit, control circuit, equipment, structure, road, or other facilities from service.

The SOR and outage plan shall be submitted to the Engineer and other affected utilities for review and acceptance a minimum of two (2) weeks in advance of the time that such outage is needed. The outage plan shall be coordinated with the construction schedule specified in these Special Provisions and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method for preventing bypassing of other facilities; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the affected facilities; and the labor, plant, and equipment which the Contractor shall provide in order to ensure proper operation.

In addition, the outage plan shall describe the Contractor's contingency plan that shall be initiated in the event that his temporary facilities fail, or it becomes apparent that the time constraints described in the approved outage plan cannot be met. The contingency plan shall conform to all specified outage requirements. All costs for preparing and implementing both the outage and contingency plans shall be borne by the Contractor.

The Contractor shall provide, Monday through Friday, at least three (3) working days prior to the actual shutdown, written confirmation of the shutdown date and time, or written notification that the schedule for performing the work has changed, or revisions to the outage plan are required.

Operations of the City's facilities and utilities are critical to the public health and safety of the citizens of Stockton. Sufficient facilities to serve the needs and demands of the City shall remain in service at all times. The City and/or affected utility owner shall be the sole judge of its needs and the facilities that must remain in service to provide adequate service.

The Contractor shall coordinate and cooperate with the City and utilities to establish the Contractor's schedule for work at the entire project facilities. The approved project schedule shall be subject to change, as it pertains to site work and shutdowns, when required by the City/utilities to accommodate unforeseen or emergency situations in the operation of the affected facilities.

10-1.06 Directional Boring

Contractor's attention is directed to the provisions in Section 77-1.08, "Conduit" of these Special Provisions and Sections 86-1.02B, "Conduit and Accessories" and 87-1.03B, "Conduit Installation" of the Caltrans Specifications for the installation of signal and ITS conduits. Should the contractor desire to use other type(s) of conduit such as HDPE for

the ITS conduits then the Contractor should submit the material specifications for the proposed conduit to the Engineer for his review and approval. Contractor's attention is also directed to the provisions in Section 5-1.05 "Submittals" of these Special Provisions.

Directional Boring under railroad tracks shall be a minimum of 3'-6" below the railroad ties. No trenching will be allowed within the railroad right of way. The Contractor shall comply with all requirements set forth by the CPUC and other rail authority.

A. General

1. Quality Assurance

The requirements set forth in this document specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this specification. Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this specification, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

2. Submittals

a. **WORK PLAN:** Prior to beginning work, the Contractor must submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the project. Plan should document the thoughtful planning required to successfully complete the project.

b. **EQUIPMENT:** The Contractor shall submit specifications on directional boring equipment to be used to ensure that the equipment will be adequate to complete the project. Spares inventory shall be included.

c. **MATERIAL:** Specifications on material to be used shall be submitted to the Engineer. Material shall include the conduit, fittings and any other item which is to be an installed component of the project.

d. **PERSONNEL:** Documentation of training and relevant experience of personnel shall be submitted.

B. Equipment Requirements

1. General

The directional boring equipment shall consist of a directional boring rig of sufficient capacity to perform the bore and pullback the conduit, a boring fluid mixing and delivery system of sufficient capacity to successfully complete the boring, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2. Boring System

a. BORING RIG: The directional boring machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill conduit into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the directional boring. The hydraulic power system shall be self-contained with sufficient pressure and volume to power boring operations. The hydraulic system shall be free of leaks. The rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during boring and pull-back operations. Sufficient spares shall be kept on hand for any break-downs which can be reasonably anticipated.

b. BORE HEAD: The bore head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and boring fluid jets.

3. Guidance System

The Guidance System shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

C. Operations

1. General

The Engineer must be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Inspector is present at the job site and agrees that proper preparations for the operation have been made. The Inspector's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. The conduit shall be installed below the minimum depth of 24" unless directed otherwise by the Engineer.

2. Boring Procedure

a. SITE PREPARATION: Prior to any alterations to the work site, the Contractor shall photograph or video tape the entire work area, including entry and exit points. One copy of which shall be given to the Engineer and one copy shall remain with the Contractor for a period of one year following the completion of the project.

The work site, as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.

b. BORE PATH SURVEY: The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on the drawings. If the Contractor is using a magnetic guidance system, the drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

c. ENVIRONMENTAL PROTECTION: The Contractor shall protect all boring operation areas and any drainage or other area designated for such protection by contract documents and/or state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or boring fluid spills shall be put in place. The Contractor shall adhere to all applicable environmental regulations.

d. UTILITY LOCATES: the Contractor shall notify all companies with underground utilities in the work area via the state or local "one-call" to obtain utility locates. Once the utilities have been located the Contractor shall physically identify the exact location of the utilities by vacuum or hand excavation, when possible, in order to determine the actual location and path of any underground utilities which might be within 4 feet of the bore path. The Contractor shall not commence boring operations until the location of all underground utilities within the work area have been verified.

e. SAFETY: The Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to the Engineer.

f. CONDUIT: Conduit shall be connected together in one length prior to pull-back operations, if space permits. The Contractor's attention is called to the fact that extreme care will be required when placing the conduit so as to permit the installation of the conduit to the alignment and depth, as shown on the Plans and these Special Provisions. Variations from theoretical grade of the conduit at the time of completion of boring shall not exceed one percent of the distance from the bore pit point.

g. PILOT HOLE: Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100'.

h. BORE PIT: Where ground conditions at the face of the bore pit are such that sloughing or caving of ground is likely to occur at the face of the excavation upon commencement thereof, the face of the pit shall be made stable so that an excessive void is not carried with the face of the excavation for the length of the casing or conduit. This may be accomplished by solid sheathing at the portal of the bore pit, or excavating and backfilling the face of the bore pit with cohesive material.

i. REAMING: Upon successful completion of pilot hole, the Contractor shall ream bore hole to a minimum of 25% greater than outside diameter of conduit using the appropriate tools. The Contractor shall not attempt to ream at one time more than the boring equipment are designed to safely handle.

j. PULL-BACK: After successfully reaming the bore hole to the required diameter, the Contractor shall pull the conduit through the bore hole. In front of the conduit shall be a swivel. Once pull-back operations have commenced, operations must

continue without interruption until conduit is completely pulled into the bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe conduit pull pressure at any time.

In the event that conduit becomes stuck, the Contractor shall cease pulling operations to allow any potential hydro-lock to subside and shall commence pulling operations. If conduit remains stuck, the Contractor shall notify the Engineer. The Engineer and the Contractor shall discuss options and then work shall proceed accordingly.

k. EXCAVATED MATERIAL: In general, excavated material shall be removed from the conduit as boring progresses and no accumulation of excavated material within the conduit will be permitted. Should appreciable loss of ground occur in installations where the face of the excavation is accessible, the voids shall be backpacked promptly to the extent practicable with an approved soil cement.

3. Site Restoration

Following boring operations, the Contractor shall de-mobilize equipment and restore the work site to its original condition. All excavations shall be backfilled and compacted according to the City of Stockton requirements.

4. Record Keeping, As-Builts

The Contractor shall maintain a daily project log of boring operations and a guidance system log with a copy given to the Engineer at the completion of the project. As-built drawings shall be certified as to accuracy by the Contractor.

10-1.07 Sheeting and Shoring

Attention is directed to the Section 10-1.02E, "Excavation" of the Caltrans Specifications. Excavations shall be adequately shored and braced so that the earth will not slide, move, or settle, and so that all existing improvements of any kind will be fully protected from damage.

Attention is called to Article 6 of "Construction Safety Orders" of the California Division of Industrial Safety, which applies to all open excavations made in the earth's surface, including trenches.

Trenches over five (5) feet in depth requires a permit from California Division of Industrial Safety and shall be evaluated for stability prior to personnel entering the trench. Where trenches are deeper than five (5) feet, the Contractor shall comply with the California Occupational Safety and Health Administration (CAL OSHA) requirements pertaining to trench safety.

The Contractor shall furnish, install, and maintain such sheet piling, timbering, lagging, and bracing as indicated on the standard drawings or any additional precautions not specifically set forth as necessary to support the sides of the trench. The protection of adjacent structures from movement of the ground and the elimination of the element of danger to life, property, or to existing improvements is the intent of this requirement.

Additional supports requested by the Engineer shall in no way relieve the Contractor of his responsibility for the sufficiency of his precautions.

All such piling, timbering, lagging, and bracing shall, unless otherwise required by the Engineer, be removed during backfilling in such a manner as to prevent any movement of the ground or damage to the piping or other structures.

10-1.08 Surface Restoration

Surface restoration shall consist of restoring all areas within the limits of work to their original existing condition prior to construction or to the condition shown on the plans or specified in the Specifications.

The Contractor shall restore all paved areas, such as driveways, curb and gutter, sidewalk, roadway surfaces, ditches, etc., landscaped areas, and all other improvements disturbed or damaged by his operations.

Payment for the restoration of damaged areas, for which specific bid items are not provided, shall be included in the prices paid for various items of work and no additional compensation will be allowed therefore.

SECTION 11 – BLANK

SECTION 12 – TEMPORARY TRAFFIC CONTROL

Attention is directed to Part 6 of the California MUTCD, and Sections 12, "Temporary Traffic Control", of the Caltrans Specifications, Standard Specifications, and these Special Provisions.

12-1.01 Maintaining Traffic

Attention is directed to Part 6 of the California MUTCD, Sections 7-1.03, "Public Convenience", 7-1.04, "Public Safety", Section 12-4 "Maintaining Traffic", of the Caltrans Specifications, and Section 10-1.01, "Order of Work", of these Special Provisions. Nothing in these Special Provisions shall be construed as relieving the Contractor from the responsibilities specified in these sections.

The Contractor shall furnish, and maintain in good working order, all barricades and flashers, and provide flaggers as necessary to protect pedestrians, bicyclists, and vehicular traffic. The Contractor shall furnish and maintain all barricades, flashers, and any detour signs twenty-four (24) hours a day, including covering or removing signs during non-construction hours.

The Contractor shall provide adequate and continuous ingress and egress for all adjacent properties; except for the limited period of time it is necessary to perform work at a specific property. The Contractor shall diligently prosecute all work directly impacting businesses to completion. The Contractor shall coordinate limited closures with tenants or owners, as required by these Special Provisions, and as directed by the Engineer. The Contractor

shall cover signal heads with traffic jackets, signs and other traffic control devices that may conflict with any detours.

The Contractor shall submit to the City Engineer a detailed "Traffic Control Plan" for review and approval. The "Traffic Control Plan" shall be submitted no later than ten (10) working days following the Notice to Proceed date and at least 3 working days prior to commencing any work which requires implementation of any component of the "Traffic Control Plan". The plan shall be approved by the Engineer prior to its implementation by the Contractor.

The "Traffic Control Plan" shall conform to the typical traffic control details included in the Caltrans Standard Plans, Part 6 of the California MUTCD, and the requirements of Section 12-1.02, "Traffic Control System for Lane Closure", of these Special Provisions. The Traffic Control Plan shall include, but not be limited to, detailed requirements for the following:

- ◆ Traffic control devices, including signs and markings.
- ◆ Construction routes, phasing and/or staging of both the roadway and sidewalk areas.
- ◆ Employee, Customer, and Business/Delivery access to adjacent property.
- ◆ Emergency vehicles access.
- ◆ Bus, refuse collection, and mail delivery access.
- ◆ Any parking zones to be removed on a temporary basis.
- ◆ Pedestrian and bicyclist access.

The Traffic Control Plan shall consider the impacts of changes in traffic volumes and capacities related to the construction activities, and their impact on vehicular and bicycle traffic and pedestrian operations, on roadway pavements, including provisions to restore construction-damaged pavements.

Traffic Lane and Sidewalk Closures

Lanes and sidewalks may be closed only as indicated in the Section 12, of these Special Provisions. Except for work required under Section 7-1.03 "Public Convenience" and Section 7-1.04, "Public Safety" of the Standard Specifications, work that interferes with public traffic shall be performed only as indicated. Traffic lane and sidewalk closures shall conform to the following requirements:

Lane closure, a maximum of one lane in each direction of travel, not less than twelve (12) feet wide, shall be permitted only between the hours of 9:00 a.m. and 3:30 p.m. Any lane closures other than specified shall be approved by the Engineer.

Standard working hours shall be 9:00 a.m. to 5:00 p.m. Any extended working hours require the approval of the Engineer.

Personal vehicles of the Contractor's employees shall not be parked on the traveled way or shoulders, including any section closed to public traffic.

Adequate ingress and egress shall be maintained throughout the project limits for fire, police, and other emergency vehicles. The Contractor shall provide adequate ingress and egress for residences, property owners, and abutting business owners to their respective properties except when performing work at their specific locations.

Also, the Contractor shall provide adequate signing, barricades and flashers or portable flashing beacons, flaggers, and other equipment and personnel necessary to adequately control and direct traffic in a safe manner. The Contractor shall maintain all barricades, flashers and detour signs twenty-four (24) hours a day, including covering signs during non-construction hours. The Contractor shall also provide the City with the names and telephone numbers of three (3) representatives available at all times.

Except as otherwise allowed by the Engineer, "long term" and temporary closures shall be removed and the full width of the traveled way shall be open for use by public traffic when construction operations are not actively in progress during the working period or successive working periods.

The contractor shall provide for pedestrian and wheelchair access to at least one (1) intersection corner within each block and the abutting sidewalk facilities along each block, at all times. Simultaneous closure of both intersection corners to pedestrian traffic within the same block is not allowed.

The contractor shall maintain at least one (1) north/south crosswalk and one (1) east/west crosswalk open to pedestrian and wheelchair access, where exists, at each intersection at all times.

Whenever Contractor's vehicles or equipment are parked within six (6) feet of a traffic lane, the area shall be closed with fluorescent traffic cones or portable delineators placed on a taper in advance of the parked vehicles or equipment and along the edge of the traffic lane at twenty-five (25) foot intervals to a point not less than twenty-five (25) feet past the last vehicle or piece of equipment. A minimum of nine (9) cones or portable delineators shall be used for the taper. A W20-1 (Road Work Ahead) sign shall be mounted on a portable sign stand with flags. The sign shall be placed where directed by the Engineer.

Temporary Pedestrian Access Routes

Attention is directed to Section 12-4.04, "Temporary Pedestrian Access Routes" of the updated Caltrans Specification and these Special Provisions.

When a pedestrian circulation path is temporarily closed by construction, alterations, maintenance operations, or other conditions, contractor shall submit a work plan for a temporary pedestrian access route complying with Caltrans Specification Section 12-4.04A(3) and sections 6D.01, 6D.02, and 6G.05 of the MUTCD, and State Standard plans T30, T31, T32, T33, and T34 shall be provided. The work plan must Be sealed and signed by an engineer who is registered as a civil engineer in the State

Whenever possible work should be done in a manner that does not create a need to detour pedestrians from existing pedestrian routes. Extra distance and additional

pedestrian street crossings add complexity to a trip and increase exposure of risk to accidents. The alternate pedestrian routes shall be accessible and detectable, including warning pedestrians who are blind or have low vision about sidewalk closures. Proximity-actuated audible signs are a preferred means to warn pedestrians who are blind or have low vision about sidewalk closures.

The surface shall be skid-resistant and free of irregularities. Pedestrian walkways shall be maintained in good condition, and shall be suitable for wheelchair use. Walkways shall be kept clear of obstructions.

The Contractor shall cause the least possible disruption to the affected properties and restore suitable pedestrian access immediately following completion of the active work in progress.

At least one (1) continuous walkway along one (1) side of the street shall be available at all times. At locations where work is actively in progress, the pedestrian walkway within a single block may be temporarily closed at one (1) end of the block along one (1) side of the street. Pedestrians shall be rerouted to the walkway on the opposite side of the street.

Minor deviations from the requirements of this section, which do not significantly change the cost of the work, may be permitted upon the written request of the Contractor if, in the opinion of the Engineer, public traffic will be better served and the work expedited. These deviations shall not be adopted by the Contractor until the Engineer has approved them in writing. All other modifications will be made by contract change order.

12-1.02 Traffic Control System for Lane Closure

A traffic control system shall consist of closing traffic lanes in accordance with the details shown on the plans, the provisions of Section 12, "Temporary Traffic Control", of the Caltrans Specifications, and Standard Specifications, and these Special Provisions.

The provisions in this section will not relieve the Contractor from the responsibility to provide additional devices or take the measures that may be necessary to comply with the provisions in Section 7-1.04, "Public Safety", of the Standard Specifications and these Special Provisions.

During traffic striping operations and pavement marker placement operations using bituminous adhesive, traffic shall be controlled, at the option of the Contractor, with either stationary or moving type lane closures. During all other operations, traffic shall be controlled with stationary type lane closures. The Contractor's attention is directed to the provisions in Sections 84-2.03, "Construction", of the Caltrans Specifications.

If any component in the traffic control system is displaced, or ceases to operate or function as specified, from any cause, during the progress of the work, the Contractor shall immediately repair the component to its original condition or replace the component, and shall restore the component to its original location.

When lane closures are made for work periods only, at the end of each work period, all components of the traffic control system, except portable delineators placed along open

trenches or excavation adjacent to the traveled way shall be removed from the traveled way and shoulder. If the Contractor so elects, the components may be stored at selected central locations, approved by the Engineer, within the limits of the highway right-of-way.

Each vehicle used to place, maintain, and remove components of a traffic control system shall be equipped with a Type II flashing arrow sign, which shall be in operation when the vehicle is being used for placing, maintaining, or removing the components. Vehicles equipped with Type II flashing arrow signs not involved in placing, maintaining, or removing the components when operated within a stationary type lane closure shall only display the caution display mode. The sign shall be controllable by the operator of the vehicle while the vehicle is in motion. The flashing arrow sign shown on the plans shall not be used on the vehicles which are doing the placing, maintaining, and removing of components of a traffic control system, and shall be in place before a lane closure requiring its use is completed.

The Contractor shall pay fully the cost of furnishing all flaggers, including transporting flaggers, to provide for passage of public traffic.

Attention is directed to Part 6 of the California MUTCD. Nothing in these Special Provisions shall be construed as relieving the Contractor from his responsibility as provided in Part 6 of California MUTCD.

12-1.03 Type K Temporary Railing

The Contractor shall install temporary railing (Type K) between a lane open to public traffic and an excavation, obstacle, or storage area when the following conditions exist:

- A. Excavations - the near edge of the excavation is twelve (12) feet or less from the edge of the lane, except:
 - 1. Excavations covered with sheet steel or concrete covers of adequate thickness to prevent accidental entry by traffic or the public.
 - 2. Excavations less than one (1) foot deep.
 - 3. Trenches less than one (1) foot wide for irrigation pipe or electrical conduit, or excavations less than one (1) foot in diameter.
 - 4. Excavations parallel to the lane for the purpose of pavement widening or reconstruction.
 - 5. Excavations in side slopes, where the slope is steeper than 1:4 (vertical:horizontal).
 - 6. Excavations protected by existing barrier or railing.

- B. Temporarily Unprotected Permanent Obstacles - the work includes the installation of a fixed obstacle together with a protective system, such as a sign structure together with protective railing, and the Contractor elects to install the obstacle prior to installing the protective system; or the Contractor, for the Contractor's convenience and with permission of the Engineer, removes a portion of an existing protective railing at an obstacle and does not replace such railing complete in place during the same day.

- C. Storage Areas - material or equipment is stored within twelve (12) feet of the lane and the storage is not otherwise prohibited by the provisions of the Standard Specifications and these Special Provisions.

The approach end of temporary railing, installed in conformance with the provisions in this section, "Public Safety", and in Section 7-1.04, "Public Safety", of the Caltrans Specification, shall be offset a minimum of fifteen (15) feet from the edge of an open traffic lane. The temporary railing shall be installed on a skew toward the edge of the traffic lane of not more than one (1) foot transversely to ten (10) feet longitudinally with respect to the edge of the traffic lane.

If the fifteen (15) feet minimum offset cannot be achieved, the temporary railing shall be installed on the 10 to 1 skew to obtain the maximum available offset between the approach end of the railing and the edge of the traffic lane, and an array of temporary crash cushion modules shall be installed at the approach end of the temporary railing.

Temporary Railing shall conform to the provisions in Section 12-3.20, "Type K Temporary Railing", of the Caltrans Specifications. Temporary Railing, conforming to the details shown on Caltrans Standard Plan T3A and T3B, may be used.

12-1.04 Temporary Pavement Delineation

Temporary pavement delineation shall be furnished, placed, maintained, and removed in conformance with the provisions in Section 12-6 "Temporary Pavement Delineation" of the Caltrans Specifications and these Special Provisions. Nothing in these Special Provisions shall be construed as reducing the minimum standards specified in the California MUTCD or as relieving the contractor from the responsibilities specified in Section 7-1.04, "Public Safety", of the Caltrans Specifications, Standard Specifications, and these Special Provisions. Whenever the work causes obliteration of existing pavement delineation, temporary or permanent pavement delineation shall be in place prior to opening the traveled way to public traffic. Lane line or centerline pavement delineation shall be provided at all times for traveled ways open to public traffic.

The Contractor shall perform the work necessary to establish the alignment of temporary pavement delineation, including required lines or marks. Surfaces to receive temporary pavement delineation shall be dry and free of dirt and loose material. Temporary pavement delineation shall not be applied over existing pavement delineation or other temporary pavement delineation. Temporary pavement delineation shall be maintained until superseded or replaced with a new pattern of temporary pavement delineation or permanent pavement delineation.

Temporary pavement markers, including underlying adhesive and removable traffic tapes which are applied to the final layer of surfacing or existing pavement to remain in place or which conflicts with a subsequent or new traffic pattern for the area, shall be removed when no longer required for the direction of public traffic, as determined by the Engineer.

12-1.05 Blank

12-1.06 Maintaining Existing and Temporary Electrical Systems

Maintaining existing electrical systems and communication systems shall conform to the provisions of Section 87, "Electrical Systems," of the Caltrans Specifications and these Special Provisions. Existing traffic signal systems and communication systems shall be kept in effective operation for the benefit of the traveling public during the progress of the work, except when shut down is permitted. The traffic signal shutdowns shall be limited to the hours of 9:00 a.m. to 3:30 p.m., and shall be permitted only during the switch over from existing to new controller operation, unless prior approval is obtained from the Engineer. Contractor required to obtain authorization at least three (3) working days before interrupting communication between an existing system and the traffic management center (TMC).

Temporary standards with signal equipment may be required during the construction of the new installation. The Contractor shall provide temporary equipment if deemed necessary by the Contractor or Engineer. The cost of the temporary systems shall be included in the lump sum price paid for the various contract items of work involved and no additional compensation shall be allowed therefor.

12-1.07 Barricades and Channelizers

Barricades shall be furnished, placed and maintained at the locations shown on the approved Traffic Control Plan (TCP), specified in Part 6 of the California MUTCD, in the Standard Specifications or in these Special Provisions or where designated by the Engineer. Barricades shall conform to the provisions in Section 12, "Temporary Traffic Control," of the Standard Specifications and these Special Provisions.

Attention is directed to Section 6-1.02 "Pre-qualified and Tested Signing and Delineation Material" of these special provisions regarding retroreflective sheeting for barricades.

Construction area sign and marker panels conforming to the provisions in Part 6 of the California MUTCD and Section 12, "Temporary Traffic Control," of the Caltrans Specifications, Standard Specifications, and these Special Provisions shall be installed on barricades in a manner determined by the Engineer at the locations shown on the plans and the TCP. Where provided, pedestrian barricades and channelizing devices shall comply with sections 6F.63, 6F.68, and 6F.71 of the MUTCD.

Channelizers shall conform to the provisions in Section 12, "Temporary Traffic Control," of the Caltrans Specifications, Standard Specifications, and these special provisions.

Channelizers shall conform to the provisions in Section 6-1.07 "Pre-qualified and Tested Signing and Delineation Material" of these Special Provisions.

At the time of completion of the project, certain channelizers shall be left in place as determined by the Engineer.

When no longer required for the work as determined by the Engineer, channelizers

(except channelizers to be left in place) and underlying adhesive used to cement the channelizer bases to the pavement shall be removed. Removed channelizers and adhesive shall become the property of the Contractor and shall be removed from the site of work.

SECTION 13 – WATER POLLUTION CONTROL

13-1.01 General

Attention is directed to Sections 13, "Water pollution Control", of the Caltrans Specifications, these Special Provisions, and as directed by the Engineer.

The Contractor shall develop and implement a Storm Water Pollution Prevention Plan (SWPPP), which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters. The Contractor shall inspect and maintain all BMPs.

Full compensation for water pollution control shall be considered as included in the prices paid for various items of work, and no additional compensation will be allowed therefore.

SECTION 14 – ENVIRONMENTAL STEWARDSHIP

Attention is directed to Sections 14, "Environmental Stewardship", of the Caltrans Specifications, these Special Provisions, and as directed by the Engineer.

14-1.01 Construction Site Waste Materials Management

Removal of existing traffic stripes and marking shall be per Caltrans Specifications Section 84-9, "Existing Markings".

Where grinding or other methods approved by the Engineer are used to remove thermoplastic traffic stripes and pavement markings, the removed residue, including dust, shall be tested for lead and chromium content. If the thermoplastic grindings are found to be hazardous, the materials shall be disposed of at a Class 1 facility.

Residue from removing traffic stripes and pavement markings which contains lead from the paint or thermoplastic. The average lead concentrations are less than 1,000 mg/kg total lead and 5 mg/L soluble lead. This residue:

1. Is a nonhazardous waste
2. Does not contain heavy metals in concentrations that exceed thresholds established by the Health and Safety Code and 22 CA Code of Regs
3. Is not regulated under the Federal Resource Conservation and Recovery Act (RCRA), 42 USC § 6901 et seq.

Submit a lead compliance plan under section 7-1.02K(6)(j)(ii) "Lead Compliance Plan", of the Caltrans Specifications.

Earth Material Containing Lead

This section includes specifications for handling, removing, and disposing of earth material containing lead.

Submit a lead compliance plan.

If earth material is disposed of:

1. Disclose the lead concentration of the earth material to the receiving property owner when obtaining authorization for disposal on the property
2. Obtain the receiving property owner's acknowledgment of lead concentration disclosure in the written authorization for disposal
3. You are responsible for any additional sampling and analysis required by the receiving property owner

If you choose to dispose of earth material at a commercial landfill:

1. Transport it to a Class III or Class II landfill appropriately permitted to receive the material
2. You are responsible for identifying the appropriately permitted landfill to receive the earth material and for all associated trucking and disposal costs, including any additional sampling and analysis required by the receiving landfill

Soil Handling

Excess soils must be handled as potential hazardous waste, or the excess soils must be tested for concentrations of lead prior to disposal.

Contaminated Soil

Identify contaminated soil from spills or leaks by noticing discoloration, odors, or differences in soil properties. Soil with evidence of contamination must be sampled and tested by a laboratory certified by Environmental Laboratory Accreditation Program (ELAP).

If levels of contamination are found to be hazardous, handle and dispose of the soil as hazardous waste.

Prevent the flow of water, including ground water, from mixing with contaminated soil by using one or a combination of the following measures:

1. Berms
2. Cofferdams
3. Grout curtains
4. Freeze walls
5. Concrete seal course

If water mixes with contaminated soil and becomes contaminated, sample and test the water using a laboratory certified by ELAP. If levels of contamination are found to be hazardous, handle and dispose of the water as hazardous waste.

Upon completion of underground facilities and backfilling of the trenches in each portion of the work, the sub-grade shall be prepared by compacting to a relative compaction of not less than ninety-five (95) percent for a minimum depth of zero point five (0.5) feet below the grading plane (sub-grade plane) for a total width of the area to be paved.

All portland cement concrete flatwork shall be saw-cut a minimum of 3-1/2 inches deep prior to removal. All monolithic portland cement concrete shall be saw-cut a minimum of 8 inches deep prior to removal.

Existing asphalt concrete sections to be removed shall be neatly saw cut two and one-half (2-1/2) inches deep and excavated to a depth of fifteen (15) inches. The vertical edges of the pavement shall be neatly trimmed. All debris shall be removed. The top six inches of the sub-grade shall be compacted to 90% of the maximum density at near optimum moisture content.

14-1.02 Air Pollution Control

Attention is directed to Section 14-9.02 "Air Pollution Control" of the Caltrans Specifications.

Comply with air pollution control rules, regulations, ordinances, and statutes that apply to work performed under the contract, including air pollution control rules, regulations, ordinances, and statutes provided in government code 11017 (Pub Cont Code 10231).

Do not burn material to be disposed of.

14-1.03 Dust Control, Apply Water, Site Maintenance, and Cleanup

Dust control shall conform to any requirements set forth in the San Joaquin Valley Air Pollution Control District Construction Notification Form, the provisions in Section 14-9, "Air Quality" of the Caltrans Specifications, and these Special Provisions. Use of water except for recycled, reclaimed, or other non-potable water for the purpose of dust control or other construction uses unless for health or safety purposes is prohibited. All dust control operations shall be performed by the Contractor at the time, location and in the amount ordered by the Engineer. The application of either water or dust palliative shall be under the control of the Engineer at all times." Watering shall conform to the provisions of Section 13 "Water Pollution Control" of the Caltrans Specifications and these Special Provisions. Attention is also directed to Section 18 "Dust Palliatives" of the Caltrans Specifications and these Special Provisions.

During construction, the Contractor shall remove all rubbish and debris as it is generated. Upon completion of the work, the Contractor shall remove all equipment, debris, and shall leave the site in a neat, clean condition all to the satisfaction of the Engineer. A permit shall be obtained from the Municipal Utilities Department, or California Water Service, as applicable, for construction water obtained from City hydrants. This permit shall be approved by the City of Stockton Fire Department.

The Contractor shall conduct and cause all working forces at the site to maintain the site in a neat, orderly manner throughout the construction operations. The work shall be

conducted in a manner that will control the dust. When ordered to provide dust control, the Contractor shall use water to reduce the dusty conditions all to the satisfaction of the Engineer. During construction, the Contractor shall remove all rubbish and debris as it is generated. The Contractor shall pay to the City of Stockton the sum of Two Hundred Fifty Dollars (**\$250**) for every calendar day where debris has remained on the job site overnight. Upon completion of the work, the Contractor shall remove all equipment and debris, and shall leave the site in a neat, clean condition all to the satisfaction of the Engineer.

14-1.04 Sound Control Requirements

The Contractor's attention is directed to Section 14-8.02 "Noise Control" of the Caltrans Specifications and the project specific equipment noise control measures listed in Table 8.1 below. Nothing in the Caltrans Specifications or these Special Provisions voids the Contractor's public safety responsibilities or relieves the Contractor from the responsibility to comply with other ordinances regulating noise level.

The Contractor shall comply with all local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract. Each internal combustion engine, used for any purpose on the job or related to the job, shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without the muffler.

To minimize the construction impacts to residents, the Contractor is encouraged to select the bore method (directional drilling) over conventional trenching to install new conduits.

The noise level requirement shall apply to the equipment on the job or related to the job, including, but not limited to, trucks, transit mixers, or transient equipment that may or may not be owned by the Contractor. All equipment shall have sound-control devices that are no less effective than those provided on the original equipment. The use of loud sound signals shall be avoided in favor of light warnings except those required by safety laws for the protection of personnel.

Project Specific Equipment Noise Control

Table 8-1 summarizes noise levels produced by construction equipment that is commonly used on roadway construction projects. Construction equipment is expected to generate noise levels ranging from 70 to 90 dB at a distance of 50 feet, and noise produced by construction equipment would be reduced over distance at a rate of about 6 dB per doubling of distance. The noise levels generated by the boring machine would be lower than any equipment listed in the table.

Table 8-1. Construction Equipment Noise

Equipment	Maximum Noise Level (dBA at 50 feet)
Scrapers	89
Bulldozers	85
Heavy Trucks	88

Backhoe	80
Pneumatic Tools	85
Concrete Pump	82

Source: Federal Transit Administration 1995.

Further, implementing the following measures would minimize the temporary noise impacts from construction:

All equipment shall have sound-control devices that are no less effective than those provided on the original equipment. No equipment shall have an unmuffled exhaust. As directed by the Engineer, the contractor shall implement appropriate additional noise mitigation measures as warranted. These could include, but are not specifically limited to, changing the location of stationary construction equipment, turning off idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction work, and installing acoustic barriers around stationary construction noise sources. Furthermore, construction activities shall be limited to the time period between 9:00 a.m. and 5:00 p.m.

SECTION 15 – EXISTING FACILITIES

15-1.01 Existing Facilities

Contractor attention is directed to requirements of Section 5-1.13, "Property and Facility Preservation" of these Special provisions, and 7-1.05, "Indemnification" and 7-1.06 "Insurance", of the Caltrans Specifications.

The work shall be performed in connection with various existing highway facilities (i.e., traffic signals and streetlights, storm drain pipe, catch basins, sidewalk drains, roadway pavement, roadside signs, utility boxes, trees, fences, etc.) shall conform to the provisions in Section 15, "Existing Facilities", of the Caltrans Specifications and these Special Provisions.

All traffic control signs shall be maintained. If relocation is necessary to facilitate the construction, the Contractor shall notify the Public Works Department, at (209) 937-8381, three (3) working days prior to said relocation, and request for approval as to where sign is to be temporarily relocated. Full compensation for performing such removal and reinstallation shall be considered as included in the various items of work and no additional compensation will be allowed therefore.

Fire hydrants, water valves, curb-stop boxes, and other utility facilities shall be unobstructed and accessible during the construction period.

Should the Contractor desire to have any alterations made in any utility or other improvement for Contractor's own convenience in order to facilitate Contractor's construction operations and for Contractor's sole benefit, Contractor shall make all necessary arrangements with the owners and bear all expense in connection therewith.

Removed highway facilities that are not to be salvaged shall become the property of the

Contractor and shall be disposed of according to these special provisions, Section 15 "Existing Facilities" of Caltrans specifications, and as indicated on the plans.

Items of work under this section, "Existing Highway Facilities", for which specific bid items are not provided, shall be considered as included in the prices paid for the various items of work of the bid schedule, and no additional compensation will be provided therefore.

Any contract adjustment that may be warranted due to differing site conditions will be made in accordance with the provisions of Section 4-1.02, "Changes and Extra Work", of these Special Provision.

Relocations or repairs necessitated because of existing facilities which are not shown on the plans, or are shown at substantially different locations than shown may be paid as extra work in accordance with Section 4-1.02, "Changes and Extra Work", of these Special Provisions, but only if the Engineer rules that the Contractor exercised due diligence in his operation. Due diligence may be determined by the Engineer by reviewing surface and subsurface conditions that were existing prior to exposing the facility, and determining the absence of any signs sufficient to warn a diligent Contractor of the possible existence of a facility in the area.

Utility Facilities

Attention is directed to the possible existence of underground utilities not known to the City or in a location different from that which is shown on the plans or in these Special Provisions. The Contractor shall take steps to ascertain the exact location of such facilities prior to doing any work that may damage such facilities or interfere with their service.

Remove Existing Concrete

Existing concrete sidewalk, gutter, curb and gutter, driveways, wheelchair ramps, and other concrete surfacing, where shown on the plans to be removed, shall be removed and disposed of. Concrete removal includes removal of any steel embedded in the concrete. Sawcut concrete ramps, walks, curbs, and gutters to be removed at the nearest joint or score-line, at the locations indicated on the plans, and as designated by the Engineer.

Remove Existing Pavement

Asphalt concrete pavement and aggregate base shall be removed by saw-cutting and excavation or cold planing to the lines, depths, and dimensions indicated on the plans and/or as directed by the Engineer.

Roadside Signs

Unless otherwise shown on the plans, the Contractor shall maintain existing roadside signs in place. The Contractor shall replace or repair all signs damaged by his operations and under this contract by using new material. Such material shall be a replacement of the original in regards to type of sign, posts, and construction. Relocation of the existing signs shall be done the same day the sign is removed from its original location.

At the Contractor's option, existing signs may be temporarily removed in order to facilitate the Contractor's construction of other improvements included under this contract. Any

sign which is removed or damaged by the Contractor's shall be reinstalled at its original location using new uni-strut posts in conformance with the Standard Specifications. Existing steel pipe sign posts shall be salvaged as directed by the Engineer. Each roadside sign shall be reinstalled on the same day that the sign is removed.

All new non-mast arm mounted signs shall have High Intensity Prismatic (HIP) reflective sheeting (reflectivity; ASTM type III) and covered with anti-graffiti film. The anti-graffiti film shall be transparent overlay for use on signs. The reflective sheeting and anti-graffiti film shall be from same manufacturer and guaranteed for the same number years.

SECTION 16 – BLANK

DIVISION III EARTHWORK AND LANDSCAPE

SECTION 17 – EARTHWORK AND LANDSCAPE

17-1.01 Clearing and Grubbing

Clearing and Grubbing shall conform to the requirements of Section 16, "Clearing and Grubbing", of the Standard Specifications, Section 17-2, "Clearing and Grubbing", of the Caltrans Specifications, and these Special Provisions.

All materials removed shall be off hauled and disposed of by the Contractor.

Attention is directed to Section 19-1.03D, "Buried Man-Made Objects", of the Caltrans Specifications.

Existing underground structures, trash, debris, loose fill, tree roots, tree remains, organic surficial soil, and other rubbish shall be removed or otherwise disposed of so as to leave the areas that have been disturbed with a neat and finished appearance, free from debris. Depressions left from any removals shall be properly filled and compacted in accordance with these Special Provisions, and as directed by the Engineer.

The methods for removal of subsurface irrigation and utility lines will depend on the depth and location of the line in relation to planned improvement. Unless otherwise specified, remove the pipe and compact the soil in the trench according to the applicable portions of these Special Provisions.

Where loose, uncompacted fill occurs at the surface of the site, the materials shall be excavated to expose firm natural ground or previously compacted fill. The exposed surface shall then be prepared to receive fill in accordance with the applicable portions of these Special Provisions.

Nothing herein shall be construed as relieving the Contractor of his responsibility for final cleanup of the highway as provided in Section 4-1.13, "Cleanup", of the Caltrans Specifications.

SECTION 18 – BLANK

SECTION 19 – EARTHWORK

19-1.01 Roadway Excavation

Roadway excavation shall conform to the requirements of Section 19, "Earthwork", of the Standard Specifications, Caltrans Specifications, and these Special Provisions. Wherever relative compaction is specified, it shall be determined by ASTM D1557.

Surplus excavated material shall become the property of the Contractor and shall be disposed of outside the highway right-of-way in accordance with the provisions in Section 19-2.03B, "Surplus Material", of the Caltrans Specifications. All excavated material shall be loaded for off-haul from the site as it is generated. Material will not be allowed to accumulate within the right-of-way. If excavation exceeds 15 feet, water sampling will be required.

19-1.02 Trench Excavation and Backfill

Trench excavation, pipe bedding, and backfill shall conform to the requirements of Section 71, "Sanitary Sewer and Storm Sewers", of the Standard Specifications and City of Stockton Standard Plan Nos. R36 through R43, and any amendment and revisions, these Special Provisions, and as specified on the plans. Controlled Density Fill (CDF) shall be mandatory for trenches 8" wide or less. Contractor shall grind 3" deep, 12" each side of trench, and repave. If excavation exceeds 15 feet in depth, water sampling will be required.

Water control shall conform to the provisions of Section 19-3.03B(5) "Water Control and Foundation Treatment" of the Caltrans Specifications and these Special Provisions. The Contractor shall construct and maintain all necessary ditches, cofferdams, channels, drains, sumps, and temporary protective works, and shall furnish, install, and maintain all necessary pumping and other equipment for controlling flows, including ground water in the pipe trenches and structure excavations, so that no foundation will contain any free water. Full compensation for water control shall be included in the contract prices paid for various items of work, and no additional compensation will be made therefore.

The Contractor shall do all excavation of whatever substance is encountered to the lines and grades shown on the plans. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, the void remaining after the removal of the boulders shall be backfilled with suitable material and density, as approved by the Engineer. The Contractor shall do such grading as is necessary to prevent surface water from entering the excavation. The Contractor shall remove and dispose of all water entering the excavation. Disposal of water shall be done in a manner to prevent damage or nuisance to adjacent properties.

Due to width limitations, proximity of existing utilities, structures, and access requirements, the Contractor may be required to provide a vertical, open trench, shoring system for portions of this project. Shoring of all trench excavations shall conform to the

Sheeting and Shoring Section of these Special Provisions.

The amount of open trench or plated trench permitted at any one time shall not exceed fifty (50) feet or as allowed by the Engineer. Trench excavation shall be closed and all lanes shall be restored to traffic at the end of each workday. The Contractor shall furnish and install non-skid steel plates to span trench sections, which have not been backfilled. Non-skid trench plates shall have a manufactured surface with a coefficient of friction that equals or exceeds zero point thirty-five (0.35).

Approach and ending plates shall be attached to the roadway by a minimum of two (2) dowels predrilled into the corner of the plate and drilled a minimum of two (2) inches into the pavement. Interior plates are to be butted together. Fine graded asphalt concrete shall be compacted to form ramps with a maximum slope of eight and one-half percent (8.5%) with a minimum twelve- (12) inch taper to cover all exterior edges of the plates. When the plates are removed, the dowel holes in the pavement shall be backfilled with graded fines of asphalt concrete mix. A concrete slurry or equivalent slurry mix may be substituted with the approval of the Engineer.

All operations shall be carried out in an orderly fashion. Backfilling, compacting, and clean-up work shall be accomplished as the work is approved and traffic through the work shall be impeded or obstructed as little as possible.

The trench bottom shall be free of bumps or hollows and graded to provide uniform support along the length of pipe.

Excess excavated material shall become the property of the Contractor and shall be removed and disposed of away from the job site at the Contractor's expense. Full compensation for the removal and disposal of excess or unsuitable material shall be considered included in the contract unit prices paid for the various items of work and no additional compensation will be allowed therefore.

Pipe bedding and backfill shall be placed above and below the pipe to the lines and grades shown on the City of Stockton Standard Plans Nos. R36 through R43, as shown on the plans, and as specified in these Special Provisions.

Delete Section 19-3.03E, "Structure Backfill", of the Caltrans Specifications and substitute the following:

"Pipe bedding, envelope, and trench backfill material shall consist of imported material, free from vegetable matter and other deleterious substances and shall form a firm, stable base when compacted. The percentage composition weight by weight shall conform to the following grading:

<u>Sieve Size</u>	<u>Percentage</u>
	<u>Passing</u>
1"	100
¾"	90-100
No. 4	35-60
No. 30	10-30

The material shall conform to the following quality requirements:

	<u>Requirements</u>
Resistance (R-value)	78 min.
Sand equivalent	25 min.

In no case shall native excavated material be used as pipe bedding, envelope, and trench backfill.

Bedding material shall be placed to approximately the same elevation on both sides of pipe to prevent unequal loading and displacement of the pipe. The difference in elevation of the bedding backfill on either side of pipe shall not exceed six (6) inches at any time.

Trench backfill shall consist of the trench area from the top of the pipe bedding to the ground surface, or if within a roadway, to the bottom of the roadway subgrade.

Backfill shall be compacted by impact, vibration, or by a combination of these methods, as approved by the Engineer. However, impact type compactors shall not be used around or over PVC pipe until backfill over the top of the pipe will permit compaction of the backfill material without deflecting or damaging the pipe. Jetting will not be permitted.

All backfill shall be placed in maximum eight (8) inch uncompacted lifts.

Compaction shall be determined by ASTM D1557.

The Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing until permanent paving work can be installed.

Temporary paving shall consist of asphalt cutback rolled to provide a smoother surface. All edges shall be contoured to provide a smooth transition between the existing grade and the cutback surface. The Contractor shall maintain the surface free of depressions, bumps, loose pieces, and other defects at all times. During wet weather, the Contractor shall provide a solid, non-skid surface over temporary pavement to protect the surface from damage by traffic.

Temporary pavement shall be replaced with permanent pavement, as soon as is practical after the trench is backfilled and as allowed by the Engineer.

Until the permanent pavement is placed, the base rock and temporary asphalt plant mix at the surface of the trench shall be maintained at all times. Continuous inspection and maintenance of the trench area will be required.

Any excavation shall also conform to the provisions in Section 100, "Street Opening and Pavement Restoration Regulations" of the Standard Specifications.

19-1.03 Dewatering

Attention is directed to Section 19-3.03B, "Structure Excavation", of the Caltrans

Specifications and these Special Provisions.

If an NPDES (National Pollutant Discharge Elimination System) is required for disposal of water from construction dewatering activities, it shall be obtained by the contractor prior to any dewatering activities. Contractor shall comply with SWRCB requirements for discharging water from any dewatering operation, including obtaining all necessary permits, testing, and/or monitoring.

Dewater the excavation if ground water is encountered. Continue dewatering before and during subsequent excavation to prevent damage to the work. Foundation must be free of water when footing concrete or pipes are placed.

The contractor shall dispose of the water so as not to cause damage to the public or private property, or to cause a nuisance or menace to the public or violate the law. Dewatering shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent which would cause damage or endanger adjacent structures or property. The static water level shall be drawn down a minimum of 1 foot below the bottom to excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "Boils", does not occur.

Full compensation for doing all the work involved in dewatering, water control and bedding and backfilling, and placement of temporary paving shall be considered as included in the contract prices paid for the various items of work requiring "Dewatering" and no additional compensation will be made therefore.

DIVISION VI STRUCTURES

SECTION 52 – REINFORCEMENT

52-1.01 Reinforcement

Reinforcing steel reinforcement shall conform to the provisions in Section 52, "Reinforcement", of the Caltrans Specifications. All rebar shall be Grade 60.

DIVISION VIII MISCELLANEOUS CONSTRUCTION

SECTION 77– ELECTRICAL SYSTEMS

77-1 Signal and Lighting Systems

Furnishing and installing traffic signals shall conform to Sections 86, "Electrical Work," and 87, "Electrical Systems," of the Caltrans Specifications, Section 86, "Electrical System" of the Standard Specifications, California MUTCD, and these Special Provisions.

77-1.01 Scope

- a. Work covered under this division shall include furnishing all labor, material, tools, equipment, and incidentals and doing all work involved which is required for the complete installation of the electrical work.
- b. Work or equipment not specified or shown on the Plans which is necessary for the proper operation of the work in this area shall be provided and installed at no additional cost.

77-1.02 Regulations and Code

Regulations and Code shall conform to Section 86-1.01D(1) of the Caltrans Specifications. Nothing in these plans or specifications shall be construed to permit work not conforming to the most stringent of applicable codes.

All individuals who perform work as electricians (to electrical connections 100 volt-amperes or more; Commercial and Industrial wiring, underground conduit installation, finish work and fixtures, and fire life safety), for contractors licensed as class A and C-10 electrical contractors, shall be certified according to Labor Code Sections 3099 and 3099.2. Additionally, the contractor's representative in charge on-site shall possess an IMSA certificate.

77-1.03 Certificate of Compliance, Warranties, Guarantees and Instruction Sheets

Certificate of Compliance, Warranties, guarantees and instruction sheets shall conform to Sections 86-1.01C(6), 86-1.01C(8), and 87-2.01C of the Caltrans Specifications and these Special Provisions.

All equipment furnished shall be guaranteed to the City by the manufacturers for a period of not less than one- (1) year following the date of acceptance of the project. If any part (or parts) is found to be defective in materials or workmanship within the one year period and it is determined by the Engineer or by an authorized manufacturer's representative that said part (or parts) cannot be repaired on the site, the manufacturer shall provide a replacement part (or parts) of equal kind and/or type during the repair period and shall be responsible for the removal, handling, repair or replacement, and reinstallation of the part (or parts) until such time as the traffic signal equipment is functioning as specified and as intended herein; the repair period shall in no event exceed seventy-two (72) hours, including acquisition of parts.

The one- (1) year guarantee on the repaired or replaced parts shall again commence with the date of acceptance of the project.

77-1.04 Description

Traffic signal work is to be performed at the locations shown on the Plans. Work or equipment not specified or shown on the Plans which is necessary for the proper operation of the work in this section shall be provided and installed at no additional cost.

Any Contractor-requested change, from approved Plans and Specifications, shall be made in writing to the City. No changes shall be made in the field without written approval of requested changes by the City.

The contractor is responsible to take all necessary precautions and use best practices in the industry to perform all work require to complete the project.

77-1.05 Materials General

The Contractor shall furnish and install all materials required to complete the work under this contract.

77-1.06 Equipment List and Drawings

Equipment list and drawings shall conform to the provisions in Section 86-1.01C(1) of the latest Caltrans Specifications, and these Special Provisions.

All equipment and materials that the Contractor proposes to install shall conform to these specifications and contract plans. A list of substitute equipment and/or materials along with a written descriptive summary, describing the functions of the components, which the Contractor proposes to install, shall be submitted along with his bid proposal. The list shall be complete as to the name of manufacturer, size and identifying number of each item. The list shall be supplemented by such other data as may be required. In all cases, the judgment of the Engineer shall be final as to whether substitute equipment and/or material recommended by the Contractor conform to the intent of these specifications.

THE CONTRACTOR SHALL FURNISH FINAL AS-BUILT DRAWINGS.

77-1.07 Foundations

Foundations shall conform to the provisions in Section 56-3 "Standards, Poles, Pedestals and Posts", Section 87-1.03E(3) "Concrete Pads, Foundations, and Pedestals" of the Caltrans Specifications and these Special Provisions.

Certification of the concrete shall be received from the vendor and delivered to the City Inspector at the time the concrete is poured. The foundation shall be cast monolithically up to the top 2 inches which shall be placed after the standards have been plumbed. Construction of Concrete foundations includes placement of reinforcement required per City standards.

Attention is directed to Section 51-1, "General," of the latest Caltrans Specifications regarding bonding, cold joints and construction preparations for same.

Dimensions of concrete footings for City of Stockton signal standards are shown on City of Stockton Standard Plans, Drawings R93 and R95. The 1-B pole foundation shall be installed in conformance with the City of Stockton Standard Drawings number R95.

77-1.08 Standards, Steel Pedestals and Posts

Standards, steel pedestals and posts shall conform to the provisions in Section 56.3 "Standards and Poles", and Section 87-1.03J "Standards, Poles, Pedestals, and Posts" of the Caltrans Specifications and these Special Provisions.

The Contractor shall have the Engineer locate the position of mast arm poles to determine if mast arms will be in conflict with existing overhead utilities. If relocation of utilities is required, immediate notification shall be given to the appropriate utility company.

Type 1-B shall have four (4)-bolt foundation, utilizing a cast iron pipe flange with eight (8) holes, with ornamental bolt cover. On Type 1-B poles, the ornamental cover shall rest on grouted surface. The 1-B pole shall be installed in conformance with the City of Stockton Standard Drawing number R95. The contractor shall furnish and install the ornamental cover.

All unused signal head tenons shall be capped.

The Type 15, Type 15 Duplex, and Type 15TS Lighting Standards shall be installed in conformance with the City of Stockton Standard Drawings number R88 through R92.

Grout height under poles shall be the height of the leveling nut plus a washer as a minimum and the height of the leveling nut, washer and one half inch as a maximum. This height will be measured from the highest point of grade under the pole.

All nuts used to attach standards to foundations and all bolts and nuts used to attach mast arms to standards shall be tightened with the correct size socket or box wrenches.

77-1.09 Conduit

Conduit shall conform to the provisions in Section 87-1.03B, "Conduit Installation," of the Caltrans Specifications and these Special Provisions.

All Conduits shall be Poly Vinyl Chloride (PVC), Schedule 80 with rigid steel sweeps. IMC conduit shall not be accepted. With the exception for bends to and from pull boxes and foundations the conduit shall run straight and true so that cable pulling forces are minimized. There shall be no more than 180 degree in bends. An intermediate pull box can be installed to relieve the need for additional bends at the Contractor's cost.

Insulated bonding bushings will be required on metal conduit. All nonmetallic conduits shall have a No.8 stranded (with green insulation) copper bounded/grounding wire. These bounding/grounding wires shall be connected in the pull box with cable connectors - Burndy-Servit No. KS -15 or an approved equal meeting Caltrans specifications.

Conduits into pull boxes and pole foundations shall be rigid metal and have 90-degree sweeps. Plastic pulling bells shall be installed on all conduit ends before conductors are pulled through the conduits.

After conductors have been installed, the ends of conduits terminating in pull boxes and/or controller cabinets will be sealed with an approved type of sealing compound. Refer to the City of Stockton Standard Drawing R87 for conduit/pull box details.

Refer to City of Stockton Standard Plan Drawing R37 for trench width and depth. All conduits shall be installed below the existing AC pavement regardless of the depth of the existing AC pavement.

All excavated areas in the street or sidewalk shall be completely backfilled or covered at the end of each working day and approved by the Engineer.

Where existing conduits are to be used, as directed by the Engineer, the existing conduit shall be cleaned and both old and new cables shall be pulled into the existing conduit as a unit per the Caltrans Specifications Section 87-1.03F, "Conductors and Cable Installations".

Fiber Optic Interconnect Conduits

The 2.5" rigid metal conduit between #6E pull box and the controller cabinet (for fiber optic interconnect) shall have 90-degree sweep and large radius bend. Conduit sweeps into No. 6E pull boxes on fiber optic interconnect runs shall enter, with rigid sweeps, at 45 degrees (in vertical plane). Sweeps shall be at least 24 inches below finished grade, unless approved by engineer. A pulling bell shall be installed at the end of each conduit. 3.0" PVC Schedule 80 conduit shall be installed between #6E pull boxes on fiber optic interconnect runs.

All fiber optic interconnect conduits with fiber cable shall include one 1250lbf detectable Muletape with 22 AWG wire. A detectable Muletape shall be installed after Fiber Optic cable installation for future detection.

77-1.10 Colored Controlled Density Fill (CDF)

The controlled density fill for the installations of all conduits shall be a red color to distinguish the concrete backfill from other concrete and soil. The concrete shall be pigmented by the addition of commercial quality cement pigment to the concrete mix.

The red concrete pigment shall be LM Scofield Company; Orange Chromix Colorant; or Davis Colors; or accepted equivalent. A minimum of 5 lbs. of red tint pigment shall be used per cubic yard of the CDF mix.

77-1.11 Pull Boxes

Pull boxes shall conform to the provisions in Sections 86-1.02C "Pull Boxes" and 87-1.03C "Installation of Pull Boxes" of the Caltrans Specifications, these Special Provisions, and in conformance with the City of Stockton Standard Drawings number R87.

When a pull box is subjected to vehicular traffic load, the cover shall be steel embossed with a non-skid pattern.

Pull boxes shall be placed at same elevation as adjacent standard base, service cabinet base or signal controller cabinet base if not an existing or future sidewalk area and elevation is not shown on plans. Pull boxes shall be five feet (5') from base or as shown on the plans. Pull boxes in existing or future sidewalk areas shall be placed at sidewalk elevation. The pull box elevation for pull boxes installed in median areas shall match the slope of the two adjacent curbs. The pull box elevation for pull boxes installed in planting areas adjacent to sidewalk or sidewalk area shall be at sidewalk grade. Pull boxes shall not be installed in part of wheelchair ramps, driveways or traveled way.

When pull boxes are placed in dirt and planting areas, a concrete collar shall be constructed around the pull box. The concrete collar shall be a minimum 12 inch concrete collar by 4 inch thick and at least 4 inches along the sides of the pull box to the bottom edge. The top of the pull box shall match slope of the adjacent top of curb. The surface elevation of the collar shall match the surface elevation of the pull box and slope away from the pull box at a rate of 1:50 (2%) slope.

The Contractor shall clean all existing pull boxes entered for installation of conduit or wire of all dirt and debris. All pull box lids damaged by Contractor operations shall be replaced at his/her expense. The wiring in these pull boxes shall be neatly bundled, recoiled and reinstalled in the box. Where existing pull boxes are removed and replaced with new larger boxes the existing conduits shall be cut back. When the conduits are cut, the existing conductors must either be removed or well protected. The ends of the cut conduits must have bushings placed on them.

Grout in bottom of pull boxes will not be required. Pull boxes shall be set on 6 inches of crushed rock for drainage. The conduits in the pull boxes shall be placed 2" above the crushed rock.

Recesses for suspension of ballasts will not be required.

All pull boxes shall be No. 5 unless otherwise noted on the plans.

All pull boxes shall have lids embossed with "TRAFFIC SIGNAL".

All pull boxes shall include copper grounding rods per City Standard Drawing No. R87.

All pull boxes on fiber optic interconnect runs shall be # 6 unless otherwise noted on the plans. All conduit sweeps into No. 6 pull boxes on fiber optic interconnect runs shall be 45 degrees. Contractor shall leave at least 20-foot fiber cable slack in each pull box run, between exiting conduit and entering conduit. The pull boxes shall have lids embossed with "INTERCONNECT".

A State Standard Number 6E pull box with extension (17" x 30" x variable depth (inside dimensions)) shall be installed adjacent to the traffic controller cabinet for fiber optic interconnect cable. The seam between pull box and extension shall be grouted. The optional base slab of the 6 (T) PB shall not be used. Contractor shall leave at least 50-foot fiber cable slack in pull box, between exiting conduit and entering conduit.

77-1.11.01 Street Lighting Pull Boxes

All street lighting pull boxes shall have security lids, and backfilled as indicated on City of Stockton Standard Drawing No. R87. All pull boxes shall have lids embossed with "STREET LIGHTING".

77-1.12 Conductors and Wiring

Conductors and wiring shall conform to the provisions in Sections 86-1.02F, 86-1.02I, 87-1.03F, 87-1.03H, 87-1.03I, and 87-1.03N of the Caltrans Specifications and these Special Provisions.

The Contractor shall install individual conductors type THW Polyvinyl Chloride (600 volt). Signal wires, Street Light wires, and White Neutral wires shall be 14 AWG, 10AWG, 12AWG, respectively. Signal cable shall not be used. Inert lubricant shall be used in placing conductors in the conduit.

All conductors that are to be spliced together shall be twisted a minimum of 5-turns and soldered. Then, the joint shall be held by mechanical means before insulating in accordance with Method "B."

When new conductors are to be added or existing conductors are to be removed from existing conduit, all conductors shall be removed; the conduit shall be cleaned as provided in Caltrans Specifications, Section 87-1.03F, "Conductors and Cable Installations"; and both old and new conductors as shown on the plans, shall be pulled into the conduit as a unit.

All field wiring terminating in the traffic signal controller cabinet or service cabinet shall be fastened to the termination panels with one piece copper solderless/crimpleless wire lugs. Solderless/crimpleless lug shall have offset shank and have a maximum wire size capacity of 6.

77-1.13 Fused Splice Connectors

Fused splice connectors as specified in Sections 86-1.02N "Fused Splice Connectors" and 87-1.03N "Fused Splice Connectors," of the Caltrans Specifications shall be required. Fused splice connectors shall be installed in the base of the poles, next to the inspection plate. No pigtail is allowed on the fuse holders.

77-1.14 Bonding and Grounding

Bonding and grounding shall conform to the provisions in Sections 86-1.02F(1)(c)(i), 86-1.02O, 87-1.03F(3)(c)(i), 87-1.03J, and 87-1.03O of the Caltrans Specification and these Special Provisions.

Grounding jumper shall be attached by a 3/16 inch or larger brass bolt in the signal standard or controller pedestal and shall be run to the conduit, ground rod or bonding wire in adjacent pull box. Grounding Rod shall be 5/8" in diameter and 8 foot in length.

In addition, because of past conflict monitor electronic problems associated with grounding, the Contractor shall be required to install a total of four (4) conductors between

the service pedestal and the controller cabinet. These conductors shall be installed as followed;

Green Conductor - No. 8 stranded conductor from Ground Bus #2 in controller cabinet to ground bus in service pedestal.

White Conductor - No. 8 stranded conductor from Ground Bus #1 terminal in the controller cabinet to the neutral bus in the service pedestal.

Black Conductor - No. 8 stranded conductor from the power terminal in the controller cabinet (312B) to service breaker.

Bare Copper Conductor - No. 10 solid conductor from Ground Bus #2 in controller cabinet to conduit grounding bushing in pull box.

Grounding jumper shall be visible after cap has been poured on foundation.

77-1.15 Service

Service shall conform to the provisions in Sections 86-1.02P, 87-1.03L, and 87-1.03P of the Caltrans Specifications and these Special Provisions. Each service shall be suitable for the short circuit current available at its supply terminal.

Refer to Type III AF wiring diagram on improvements plans.

If service equipment cabinet design deviates in any way from the details shown on the, details of such deviation shall be submitted to the Engineer for review before fabrication of the contract cabinets. If deemed necessary by the Engineer, one complete prototype cabinet shall be delivered to the Engineer for review at least 30 days before fabrication of the contract fixtures. The prototype cabinet will be returned to the Contractor and if permitted by the Engineer, the cabinet may be installed in the work.

The Contractor shall furnish and install Type III-AF single meter service equipment. Cabinets (See State of California Standard Plan ES-2C and ES-2D) conforming to City of Stockton Specifications shall be constructed with anodized aluminum and per the Caltrans Specifications Sections 86-1.02Q, 86-1.02P, and 87-1.03Q. A 40 amp, 120 volt, metered circuit shall be furnished to the controller cabinet for traffic signal operation. The Contractor shall confirm and provide all service requirements with Pacific Gas and Electric Company, and the City of Stockton. Refer to Attachment A (PG&E service confirmation letters). Note: 120/240 volt service houses a 4 jaw meter socket, 120/208 volt service houses a 5 jaw meter socket.

Service Cabinet Fabrication:

- Maximum width 12", Maximum height 63" with a minimum of 60" maximum depth 9". Minimum opening to control section 8.25" x 39.25".
- **Cabinet shall be fabricated with anodized aluminum.**
- Internal part shall be fabricated for 14-gauge cold steel.

- Cabinet shall be welded construction with welding materials specifically designed for material used.
- All fasteners, hinges, latches, and hardware shall be of stainless steel and hinges shall be continuous piano style.
- There shall be no exposed nuts, bolts, screws, rivets, or other fasteners on the exterior.
- Cabinet shall have enclosed swept pull section with removable step.
- Cabinet shall have fully framed ride hinged outer door with swaged close tolerance sides for flush fit with top drip lip and closed cell neoprene flange compressed gaskets.
- Cabinet door shall have 2,000 LB stress rated stainless hasp, welded to cabinet door.
- Base mounting detail shall be identical to existing cabinets for emergency Dead-front Safety Door.
- Distribution and control panel shall have separate hinged dead-front panels with 1/4 turn latch and knotted knobs.
- Breaker compartment shall be safety barriered from the control compartment.
- Dead front shall be hinged on the same side as the front door and shall open a minimum of 120 degrees.
- Removable back-pan shall be mounted on 4 welded 1/4" studs.
- The cabinet shall have a type II lock.

Power Distribution Panel:

- Main breakers shall be available as 1 pole, 2 pole, 3 pole, or 4 pole.
- Provide separate metered main, lighting main and disconnects as required.
- All circuit breakers shall be installed in a vertical position, handle up for "On," handle down for "Off".
- Circuit breaker shall be industrial grade, Westinghouse Quicklag C or equal to match existing.
- There shall be no plug-in circuit breakers.
- All bushing shall be UL approved copper THHN cable bussing, fully rated 125 Amps.

Control Compartment:

- There shall be a minimum 25" from base to circuit breakers.
- All components shall match existing components in use for maintenance of spare parts and known reliability.
- Contactors shall be Westinghouse Class A202 or other to match existing.
- The cabinet shall be wired to include a spare contactor for street lighting (See the wiring diagram detail).
- The cabinet shall be completely pre-wired in the factory.
- Wiring will be to NEMA IIB standards showing external connections and external equipment.
- All control wiring shall be 19 strand #14 AWG THHN.

- All control wires shall be permanently labeled with matching engraved clip-sleeve nylon markers.
- All terminals shall be permanently labeled.

Nameplates and Drawings:

- The function of all circuit breakers, switches and other components as required shall be identified by laminated engraved plastic nameplates with minimum 1/4 " letters fastened with minimum of two 1/4", #4-40 machine screws.
- Wiring schematics shall be Computer Aided Drafted and include all external equipment and connections per NEMA IIB.
- As built factory drawings shall be enclosed in clear plastic and held inside the outer door by weld hooks.

Certification:

- Manufacturers will be required to furnish independent laboratory certification of material preparation and finish and to confirm that the overall product meets these specifications. If this agency wishes to witness this testing, all costs to be paid by the Contractor.

Photoelectric Control:

- Photoelectric control shall be NEMA Type V, three-prong, twist-lock, and housed inside the service cabinet. Photoelectric control shall have an instant on/delay (5 second) off incorporated as per State Standards, to prevent cycling if struck by vehicle headlights. The photoelectric cell shall be solid-state unit and the photocell sensitivity shall be in compliance with PG&E LS rate requirements. Photocell socket must be made of metal and not plastic. The service cabinet shall be install such that the photoelectric control faces north.

A secondary photoelectric control system shall be wired from the mast arm street light to the service cabinet. After testing the secondary, the wire will be disconnected, coiled, and secured in the service cabinet until needed at a future date. The mast arm PEU shall have a north orientation. The photoelectric unit shall be a multi-voltage, instant on/ delay (5 sec) off, and three-prong twist-locking type unit. The photocells sensitivity shall be in compliance with PG&E LS rate requirements.

77-1.16 Signal Faces and Signal Heads

Signal faces, signal heads and auxiliary equipment as shown on the plans, and the installation thereof, shall conform to the provisions in Section 86-1.02R(4), "Signal Heads"; 86-1.02R(3), "Backplates"; 86-1.02R(2), "Signal Mounting Assemblies"; and 86-1.02R(1), "General", of the Caltrans Specifications and these Special Provisions.

In addition to Section 86-1.02R(2), "Signal Mounting Assemblies," of the Caltrans Specifications, the mounting bolt spacing, cable guide location and dimensions and terminal compartment shall conform to Caltrans Standard plan, ES-4D. Terminal compartments with hinged doors will not be accepted.

Backplate shall be fastened with stainless steel self-tapping screws.

All backplates shall be vented, colored satin black, and one piece.

Visors on mast arm hung signals shall be "tunnel" type and colored satin black with open slot at bottom.

Visors on side-mount and 1B-pole signals shall be "full circle" type and colored satin black.

All signal face indications shall have 12-inch sections (unless specifically noted on plans).

Polycarbonate traffic signal heads will not be accepted.

Lens doors shall be a type with a single wing nut/fastening bolt assembly, colored satin black, and made of stainless steel.

The framework for vehicle heads shall be colored traffic signal green.

TV-1 mountings on Type 1-B standards shall not be accepted.

77-1.17 Light Emitting Diode (LED) Vehicle Signal Lenses

All traffic signal heads shall be State approved LED modules. All the LED sections shall have internal fuses (Fusistors are not allowed). The external lens shall be smooth on the outside to prevent excessive dirt/dust buildup. The LED signal module lens shall be UV stabilized. The external lens shall be specifically designed with a sloped front face to reduce sun reflections (Sun Phantom). The LED module shall be supplied with an installed gasket. The red, yellow, and green ball modules shall have a visual appearance similar to that of an incandescent lamp (i.e. Smooth and non-pixelated). The optical assembly shall diffuse the light output and provide uniform illumination across the entire surface of circular lenses. Individual LED's shall not be visible to the observer of indications displayed by traffic signal modules, providing an incandescent type appearance. The LED arrow modules shall have a full, filled profile, reflecting a light distribution look and appearance similar to that of an incandescent lamp, without the individual LED's being visible. The arrows shall meet all applicable Caltrans specifications on light intensity.

The unit shall be repaired or replaced by the contractor if it exhibits a failure due to workmanship or material defect within the first 60 months of delivery. The unit shall be repaired or replaced if the intensity level falls below 50% of the original values within 60 months of delivery.

77-1.18 Pedestrian Signals - Light Emitting Diode (LED) Pedestrian and Countdown Signal Module

Pedestrian signals shall be State approved and conform to the following provisions:

GENERAL

Pedestrian and countdown LED traffic signals shall be 16" X 18" Type – Full Hand/Full

Man Overlay + countdown.

The framework for pedestrian signal indications shall be colored traffic signal green.

Pedestrian and countdown LED traffic signal modules shall be designed as a retrofit replacement for the message bearing surface of a nominal 16" × 18" pedestrian and countdown traffic signal housing built to the PTCSI Standard. **The message-bearing surface of the module shall be supplied with an overlapping, full "HAND" and "MAN" symbol,** that comply with PTCSI standard for these symbols for a message-bearing surface of the size specified. **The numbers 00 to 99 on the numerical display shall have 2 rows of LEDs and a minimum height of 9 inches.**

1-A INSTALLATION

- a. LED pedestrian and countdown signal modules shall not require special tools for installation.
- b. LED pedestrian and countdown signal modules shall fit into the traffic housings built to the VTCSH Standard without any modification to the housing.
- c. LED pedestrian and countdown signal modules shall be weather tight, fit securely in the housing and shall connect directly to electrical wiring.

1-B SIGNAL LENS

The lens of the LED pedestrian and countdown signal modules shall be polycarbonate UV stabilized and a minimum of ¼" thick.

The exterior of the lens of the LED pedestrian and countdown signal module shall be uniform and frosted to reduce sun phantom effect.

1-C LED PEDESTRIAN AND COUNTDOWN SIGNAL MODULE CONSTRUCTION

- a. The LED pedestrian and countdown signal module shall be a single, self-contained device, not requiring on-site assembly for installation into the existing traffic signal housing and include an installed gasket.
- b. All Portland Orange LEDs shall be "AlInGaP" technology or equal, and rated for 100,000 hours or more at 25°C and 20 mA. White LEDs must be InGaN technology.
- c. All internal LED and electronic components shall be adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- d. The signal module shall be made of UL94VO flame-retardant materials. The lens is excluded from this requirement.
- e. Each individual LED traffic module shall be identified for warranty purposes with the manufacturer's trade name, serial number and operating characteristics, i.e., rated voltage, power consumption, and volt-ampere.

1-D ENVIRONMENTAL REQUIREMENTS

- a. The LED pedestrian and countdown signal modules shall be rated for use in the ambient operating temperature range of -40°C to +60°C (-40°F to +140°F).
- b. The LED pedestrian and countdown signal modules, when properly installed with gasket, shall be protected against dust and moisture intrusion per requirements of NEMA Standard 250-1991, sections 4.7.2.1 and 4.7.3.2, for

type 4 enclosures to protect all internal LED, electronic, and electrical components.

1-E LUMINOUS INTENSITY

- a. Pedestrian and countdown LED signal modules shall be designed to operate over the specified ambient temperature and voltage range, attract the attention of, and be readable by, a viewer (both day and night) at all distances from 3 m to the full width of the area to be crossed.
- b. The luminous intensity of the LED pedestrian and countdown signal module shall not vary more than $\pm 10\%$ for voltage range of 80 VAC to 135 VAC.

1-F CHROMATICITY

The measured chromaticity coordinates of the LED signal modules shall conform to the chromaticity requirements as follows:

“Hand” shall be Portland Orange.
not greater than 0.390, nor less than 0.331, nor less than $0.997 - x$.

Walking person shall be lunar white.
x: not less than 0.290, nor greater than 0.330
y: not less than $1.5x - 0.175$, nor greater than $1.5x - 0.130$

1-G ELECTRICAL

- a. The secured, color coded, 914 mm (36 in) long, 600V, 20 AWG minimum, jacketed wires, conforming to the National Electrical Code, rated for service at $+105^{\circ}\text{C}$, are to be provided for electrical connection.
- b. The LED pedestrian and countdown signal module shall operate from a 60 ± 3 Hz AC line over a voltage range of 80 VAC to 135 VAC. Rated voltage for all measurements shall be 120 ± 3 volts rms.
- c. The LED circuitry shall prevent perceptible flicker over the voltage range specified above.
- d. The LED pedestrian and countdown signal module circuitry shall include voltage surge protection against high-repetition noise transients and low-repetition noise transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992.
- e. Catastrophic failure of one LED light source shall not result in the loss of more than the light from that one LED.
- f. The LED pedestrian and countdown module shall be operationally compatible with the currently used controller assemblies. The LED pedestrian and countdown module shall be operationally compatible with conflict monitors.
- g. The LED pedestrian and countdown module including its circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of noise.
- h. The LED pedestrian and countdown module shall provide a power factor of .90 or greater over the operating voltage range and temperature range specified above for modules with 6 watts or more.

- i. Total harmonic distortion (current and voltage) induced into an AC power line by an LED pedestrian and countdown module shall not exceed 20% over the operating voltage range and temperature range specified above.

1-H FUNCTIONS

a. Basic operation

The control and regulation module shall be of the “smart” type in order for the countdown displays to be automatically adjusted with the programmed intervals of the traffic controller.

b. Operating Modes

The module shall operate in two different modes:

- i. Full Cycle Countdown Mode – The module will start counting when the walk signal is energized. It will countdown the full walk and flashing clearance signal to reach “0” and turn off when the steady “Don’t Walk” signal turns on.
- ii. Clearance Cycle Countdown Mode – The module will start counting when the flashing clearance signal turns on and will countdown to “0” and turn off when the steady “Don’t Walk” signal turns on.

Note: The units shall be set on the Clearance Cycle Countdown Mode at the factory. The units shall be easily changed to either mode by a “jumper wire” on the back of the unit.

c. Power failure

The equipment must maintain a consistent countdown during short power failures (<1 second). A longer failure or an absence of signal superior to one (1) second must turn off display and trigger a restart system remembering the last sequence, as it is done for the NEMA traffic controller.

d. Quality Assurance

LED pedestrian and countdown modules shall be manufactured in accordance with a Vendor quality assurance (QA) program including both design and production quality assurance. All QA process and test result documentation shall be kept on file for a minimum of seven years.

e. Warranty

- i. The unit shall be repaired or replaced by the contractor if it exhibits a failure due to workmanship or material defect within the first 60 months of delivery.
- ii. The unit shall be repaired or replaced if the intensity level falls below 50% of the original values within 60 months of delivery.

77-1.19 Accessible Pedestrian Signal (APS) System

Accessible Pedestrian Push Buttons system must comply with the California MUTCD, chapter 4E. No part of the audible signal must be installed inside the controller cabinet and it shall be compatible with existing City’s system. PBS system shall consist of all electronic control equipment, mounting hardware, push buttons and signs. The PBS must have an access port for a laptop for controlling and programming the volume level and messaging. Power for the PBS must be from the pedestrian signal housing terminal

block. The system shall comply with the following requirements;

- NEMA, 250-Type 4X protection (Enclosure).
- TS4 (Electrical Reliability in section 8).
- IEC 61000-4-4 and IEC 61000-4-5 (Transient Suppression).
- FCC Title 47, Part 15, Class A (Electronic Noise).
- NEMA TS2 Section 2.1.
- Weigh less than 5 lb.
- The Control unit shall measure 7.3 by 3.6 by 1.3 inches.
- Have an internal weatherproof speaker and microphone that senses the ambient sound level.
- Adjustable operating force between 1lb and 3 lb.
- Minimum 2-inch diameter actuator.

A. The housing for the unit shall be 9”X12” (green) and made of 356 Aluminum heat-treated to meet Specification T-6. It shall be of a telescoping, vandal-proof design. The color shall be Olive Green. Adaptors may be required to install the APS pushbutton housing and the sign plate. An adaptor or a /Spacer may be required to install two 9”X12” housings side by side. The PPB shall be installed right side up to avoid water penetration.

B. The PBS must detect WALK and DON’T WALK from one Control Unit (CU) data input wire. The CU shall be mounted inside the pedestrian signal indications housing powered by 120 VAC WALK/DON’T WALK pedestrian head lamp indications, an interface panel. Each PBS shall connect to a control unit located inside its associated pedestrian signal housing. The PBS shall provide information and cues via both a vibrating arrow button and audible message indicating the” WALK SIGN IS ON”, during WALK interval. All sounds grill must be located on the back of the unit. The weather-proof speaker shall be protected by a vandal resistant screen. A sunlight visible red LED latches “ON” to confirm the button has been pushed. PBS shall include frame, sign, ADA compliant push button, and mounting hardware.

By interfacing with the Control Unit that is installed in the pedestrian signal indication housing, the PBS shall provide the following standard features:

- The system shall only have 3-wires to the PBS (power, data, ground)
- The system shall have button to button wireless synchronization capabilities via a phase partner PBS.
- The user shall be able to configure and activate the system by setting at least four different times of day on a daily, weekly, or holiday basis.
- The user shall be able to retrieve the event log by using vendor’s client application.
- The user shall be able to record and upload cumulative pedestrian count and call data.
- The user shall be able to upload voice messages, setting all volumes and features through the Bluetooth interface and using the PBS firmware.

- Confirmation of button push via latching LED, sound, and vibrotactile bounce.
- Direction of travel (with extended button push).
- Standard locating tone during Don't Walk (and clearance if desired).
- Standard voice messaging during Walk.
- Vibrating button during Walk.
- Standard locating tone or verbal countdown during clearance.
- All sounds automatically adjust to ambient over 60dB range.
- All sounds shall be synchronized.
- Extended button push shall turn on, boost volumes, and/or mute all sounds except those on activated crosswalk.
- The System shall have at the minimum seven pedestrian clearance sound options, including audible countdown.
- The system shall provide two language options.
- The system shall have at least 10 selectable WALK sound choices, including cuckoo, a chirp, a MUTCD rapid tick or custom message.

C. Mounting Height and Location. PPB's Controls shall be located no more than 5 feet offset from the extended crosswalk line, at a height of 42 inches above the finished surface, and at least 10 feet apart. The PPB's shall also be located adjacent to a paved flat area and there shall be 10 to 24-inch sides reach from the flat area to the PPB. A Push Button Frame Extender (PBFE) may be required.

D. Pedestrian Pushbutton front cover plates shall be international symbol (R10-3e MUTCD sign) and installed with security screws. The security screws shall be stainless steel, button head socket cap screws #8 diameter, 3/8 inch in length and 32 threads per inch. The socket shall be 3/32 inch Allen.

E. The Contractor shall verify with the City Traffic Engineering the types of verbal message to be programmed in each pedestrian push button.

77-1.20 Detection

77-1.20.1 Loop Detection

Detectors shall conform to the provisions in Sections 86-1.02F(1)(c)(iii), 86-1.02F(2)(d)(iii), 86-1.02W, 86-1.02U, 87-1.03U and 87-1.03V of the Caltrans Specifications and these Special Provisions.

Sensor units shall be rack mounted.

Loop detector lead-in cable, from the pull box for the detector handhole adjacent to the loop to the field terminals in the controller cabinet, shall conform to the following:

Lead-in cable shall be City approved detector loop lead-in cable and consist of 4 number 18 stranded copper conductors (Micro Loop Cable) with each conductor insulated with polyethylene. The conductors shall be twisted together with a minimum of 5 turns per

foot and the twisted pair shall be protected with a shield of aluminum polyester jacket with a thickness of 27 mils, minimum, at any point, and shall be UL listed, Style 2106. The diameter of the cable shall be 0.25-inch maximum. The diagonal pairs shall conform the following color-coding: White/Black and Red/Green.

Inductive Loop Detector Installation Details: Section 87-1.03V, "Detectors", of the Caltrans Specifications, shall be deleted and the following shall be substituted:

Loop lead-ins shall be individually identified as shown on the plans. Identification shall be by means of bands placed on the lead-in near the first splice.

The loops shall be installed in conformance with City of Stockton Standard Drawing numbers R96 through R98. All loops shall be wrapped in the slots in the same clockwise direction. The loop wire ends MUST be marked START and FINISH with loop lane/phase identification number. Splices between the loop conductors and the lead-in cable shall be made in the pull box adjacent to the loops. The loops shall be joined in the pull box in series but alternating the wire ends of adjacent loops to alternate polarity to achieve optimum sensitivity at the sensor unit. Series loops shall be marked and connected as follows. First loop - "start" end to lead-in cable. "Finish" end to "finish" wire of second loop. "Start" wire of second loop to "start" end of third loop. The alternating sequence will continue for any series of loops.

For dual left or where there are multiple lanes with presence loops adjacent to each other and the lanes are 11 feet wide and narrower, inductive loops shall be 5 feet square/diameter. For lanes wider than 11 feet, inductive loops shall be 6 feet square/diameter. All advance loops and sampler loops shall be 6 feet square/diameter, regardless of lane width.

Detector Handholes shall be Type A or B Traffic Rated, as shown on City of Stockton Standard Drawing R98. Metal triangular lids with metal rings shall be used. The point of the triangle shall face the direction of travel. Conduit from detector handhole to nearest pull box shall be 2" diameter or as shown on plans. If the handhole is located at the lip of the gutter, four (4" deep) concrete is required around the handhole.

Slots cut in the pavement shall be immediately cleaned by washing with water to remove all sawing residue and blown out and dried before installation of conductors.

After conductors are installed in the slots, the slots shall be filled with sealant. The sealant shall be at least one inch thick above the top conductor in the saw cut. Each loop shall be checked and filled with sealant after a minimum elapsed time of one hour. This is due to trapped air pockets and/or settling of the sealant.

All inductive loops and lead-in shown in areas paved with "Open Graded Asphalt Concrete" shall be installed a minimum of 2 inch deeper, as measured from the pavement surface, than shown on the drawings.

Loop detector sealant will be furnished by the Contractor. Sealant shall be Asphaltic Emulsion Induction Loop Sealant, State Spec. No. 8040-41A-15.

Loop detector sealant must be used at air temperatures above 40 degrees Fahrenheit. Sealant shall be placed 1/8 inch below pavement surface. At no time shall the sealant be installed if the ground is wet.

One-inch (1") minimum diameter holes shall be core drilled at the loop corner before slots are saw cut. Diagonal corner cuts shall not be permitted. Homerun cut must be at a 45-degree angle from any corner of the loop. If round loops are used, homerun shall be cut perpendicular to the loop slot. This prohibits the loop wire from being bent more than 90 degrees.

Conductors of all loops to be operated by each sensor unit shall be run continuous to the nearest detector handhole up to the nearest pull box. All loop wires shall have five (5) feet of slack in the pull box.

Detector loop conductors shall be Type 2 loop conductors.

Splices between loops and lead-in cable shall not be made until the operation of the loops under actual traffic conditions is approved by the Engineer. If there is more than a 24 hour lag time between the time the loops are installed and connected to the lead-in cable, both the loop conductors and the lead-in cable ends shall be water proofed until the actual splice is made (to prevent capillary action of water into the conductor insulation). The conductors and lead-in cable ends shall be waterproofed as follows:

Completely cover the conductor and lead-in cable ends with an electrical insulating coating and allowed to dry. Apply one layer of high voltage tape half-lapped then apply one layer of PVC tape half-lapped. Apply electrical insulating coating over PVC tape and at least 4 inches of conductor insulation above the cut ends.

All loops shall be marked with phase tape in the pull box as well as in the controller cabinet.

Lead-in cable for traffic signal and traffic counting installations shall be identified and banded by lane in the detector handhole and near the termination of the conduit in the controller or traffic count station cabinet. Bands shall conform to the provisions in Section 87-1.03F, "Conductors and Cable Installations," of the Caltrans Specifications.

The Contractor shall test the detectors with a motor-driven cycle, as defined in the California Vehicle Code, which is licensed for street use by the Department of Motor Vehicles of the State of California. The anodyne weight of the vehicle shall not exceed 220 pounds and engine displacement shall not exceed 100 cubic centimeters. Special features, components or vehicles designed to activate the detector will not be permitted. The Contractor shall provide an operator who shall drive the motor-driven cycle through the response or detection area of the detector at not less than 3 miles per hour or more than 7 miles per hour. The detector shall provide an indication in response to this test.

77.1.20.2 Multi Sensor Video Detection System (MSVDS)

General

The Multi Sensor Video Detection System (MSVDS) shall consist of two different technologies, video imaging and radar. The system shall detect and track vehicles at distances over 500 feet. In a low-visibility condition, the system shall be capable to switch automatically to either radar detection mode or constant call mode. The MSVDS shall fuse vehicle information from the two sensors to provide highly accurate and precise detection for simultaneous stop bar presence detection, advanced detection, and special or advanced applications. All equipment, cables, and hardware must be from the same manufacturer. The MSVDS shall match City's existing system and be compatible with City's existing cloud data collection software. No rewiring to the City of Stockton standard P controller cabinet is allowed.

System Hardware

The MSVDS shall consist of up to two hybrid video camera/radar sensors for main streets, two standard video cameras for side streets, a shelf mounted form factor Central Control Unit (CCU) with up to four detection processors capable of processing from up to four sensors, video surge suppressors, a 7-inch monitor, a keyboard, system software, and a pointing device. At locations where there is a TS1 traffic signal cabinet a SDLC Hub is required.

With use of software the system shall discriminately detects the presence of individual vehicles and bicycles in a single or multiple lanes using only the video image and sends vehicle and bicycles calls out to the controller via separate outputs. The system software shall also utilize artificial intelligence and deep learning to automatically count and detect pedestrian movement in the crosswalk, count turning movement counts and learn the back ground to count and distinguish left, through and right turn movements. The system software shall be able to work simultaneously with City's existing cloud based ATSPM and the City's cloud based DATA fusion live System. A minimum of 32 video detection zones and 32 radar detection zones per sensor shall be available.

In addition to creating vehicle and bicycle zones, the system shall provide a tracking mechanism that counts pedestrian volume moving within the crossing area, and determine the average, maximum, and minimum speed of pedestrians moving within the crossing zone. The system shall also provide discrete outputs when pedestrians are in the crosswalk during normal crossing phases (one for each direction of travel) and when a red phase input has been detected. The system shall also provide a visual indication on the video image that a pedestrian is in the crosswalk.

MSVDS Hardware

Central Control Unit (CCU)

The CCU shall be a single-rack detector card width, and provide provision for up to four sensors/cameras. The Detection Processor shall be embedded in the CCU to provide one single cabinet interface. Each sensor/camera shall be connected to the CCU via Ethernet cable. The interface connectors shall be RJ-45 type. The CCU shall have four detection status LEDs on the front panel. The CCU shall enable the loading of modified or enhanced software through either the Ethernet or front-panel USB port (using a USB thumb drive). The shelf-mount format CCU shall be powered from a 48V DC power supply. CCU power consumption shall not exceed 150 Watts. The CCU shall have logic inputs for future use.

The CCU shall incorporate surge suppression for each sensor input. The CCU shall incorporate power surge suppression both on the input power and on the power supplied to the sensors. The CCU shall incorporate power management for the various parts of the MSVDS such that if fault conditions are detected the power supply will safely shut down the power to that peripheral.

The CCU shall provide 2 USB 'A' ports on the front panel. These ports can be utilized for various functions. The USB ports shall be used as part of system setup and configuration. The CCU shall provide an output to a monitor. The port shall be HDMI. The native resolution of the monitor port shall be 1024 x 768.

An Ethernet communications port shall be provided on the front panel. The Ethernet port shall be compliant with IEEE 802.3 and shall use a RJ-45 type connector mounted on the front panel of the CCU. The Ethernet communications interface shall allow the user to remotely configure the system and/or to extract calculated vehicle/roadway information. The interface protocol shall be documented or interface software shall be provided. Each MSVDS shall have the capability to be IP addressable. The CCU shall support data rates of up to 100Mbps.

The CCU shall provide an SDLC connection to the traffic controller. The connector shall be a 'D-15' type, in compliance with NEMA TS-2 specifications. The CCU shall provide a Wi-Fi connection. The connection shall be over a standard 2.4GHz connection. The Wi-Fi connection shall be enabled and disabled by a switch on the CCU. The CCU shall provide an indicator when the Wi-Fi connection is active. The CCU shall provide a connection for a removable antenna. The antenna connection shall be a SMA Male type.

MSVDS Sensor/Camera

The MSVDS sensor shall have two components; a camera sensor and a radar sensor. The MSVDS sensor shall utilize a single shielded CAT5E or CAT6 cable for power, communications and video. Cable termination at the camera shall not require crimping or special tools. An optional RJ45 direct connector shall be made available.

The MSDS shall detect vehicles and bicycles and pedestrians in real time as they travel across each camera detection zone. Vehicles, bikes, and pedestrians' detection outputs shall be on separate channels within the same field of view. The MSVDS shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference or loss of the video and/or radar signal.

A user-selected alarm output shall be available to be used during the low-visibility condition that can modify the controller operation if connected to the appropriate controller input modifiers (Max1 or Max2). The system shall automatically revert to normal detection mode when the low-visibility condition no longer exists. An On-Screen Icon shall be displayed while the system is in this mode. Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, sensor placement, camera image quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to sensor location or quality. Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.

In addition to the count type zone, the MSVDS shall be able to calculate average speed and lane occupancy for all the video detection zones independently. These values shall be stored in non-volatile memory for later retrieval.

The MSDS shall have the capability to change the characteristics of a detection zone based on external inputs such as signal phase. Each detection zone shall be able to switch from one zone type (i.e. presence, extension, pulse, etc.) to another zone type based on the signal state.

The On-Screen Display shall include an Automatic Traffic Volume graph. This graph will display estimated Vehicles Per Hour (VPH) per movement for each camera view. The graph will display a rolling 24-hour period of VPH. The On-Screen Display shall include an Occupancy Graph. This graph will display estimated approach occupancy for each camera view. The graph will display a rolling 24-hour period of Occupancy. The On-Screen Display shall include a Speed Graph. This graph will display average speed of vehicles through each sensor view for the last Bin Interval. The graph will display a rolling 24-hour period of Speed.

Installation

The CCU shall be appropriately grounded to the cabinet ground rod using 14 AWG (2.5mm²) minimum. The cable to be used between the MSVDS sensor/Camera and the CCU in the traffic cabinet shall be Cat-5e, shielded, direct burial. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. Shielded RJ-45 connectors shall be used where applicable. The MSVDS system shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided. Each cable shall be tagged in cabinet as well as in the pull box near each associated traffic signal pole. The following configuration shall be used for Cat5e/Cat6 cable installation.

Cable Color	Phases	CCU Port
Red	2 & 5	1
Green	4 & 7	2
Blue	6 & 1	3
Yellow	8 & 3	4

Warranty

Furnish minimum of 3-year replacement warranty from the manufacturer against defects in material and workmanship or failures. The effective date of the warranty is the date of acceptance of the project. Submit all warranty documentation before installation. Replacement parts must be furnished within 10 days of receipt of a fail unit. The City does not pay for replacement. During the warranty period, updates to DP software shall be available from the supplier without charge.

Maintenance and Support

The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the video detection system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.

The supplier shall maintain an ongoing program of technical support for the video detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on-site technical support services. Installation or training support shall be provided by a factory-authorized representative and shall be a minimum IMSA-Level II Traffic Signal Technician certified.

77-1.21 Solid State Traffic Actuated Controllers

Solid-state traffic actuated controller units, cabinets, and auxiliary equipment shall conform to these Special Provisions.

Installation: NEMA TS 2 Type 2 Traffic Signal Controller.

NEMA TS 2 Type 2 controller, with auxiliary equipment and cabinet shall be furnished and installed by the contractor. The controller shall be in a 16-phase frame assembly with auxiliary equipment housed in a City of Stockton Standard Type P cabinet, TS 2 Type 2, as specified below. Solid-state switching devices shall conform to the provisions in Section "Solid-State Switching Devices," of these Special Provisions, and the following:

The controller shall meet the most current Caltrans Transportation Electrical Equipment Specifications (TEES) and fully field tested and accepted by the City (prior to the bid date of this special provision). Controller shall have Linux operating system. The controller shall be supplied with D4 V1.5L40(1C)9571D firmware and communicating with the City's existing KITS and TransSuite central traffic control servers. The controller shall be provided with the following items:

- 1) Quality Control (QC) test sheet
- 2) Vendor's test report
- 3) All the accessories, including 1B, and ATC communication modules

- 4) One copy of the latest D4 user manual
- 5) 4 GB USB flash drive

77-1-21.1 Solid-State Switching Devices

Signal light circuits shall be controlled externally to each controller unit by 3-circuit solid-states switching devices, which shall be plug-in mounted to a base. Each circuit shall have a minimum rating of 1,000 watts for tungsten lamp or gas tubing transformer load at 120 volts, AC. Solid-state switching devices shall be unaffected by transient voltages when tested in accordance with California Test 667. The switching devices shall meet the requirements of Section 5, "Solid-State Load Switches" of NEMA Standards Publication No.TS1.

Solid-state switching devices shall be provided with an indicator light for each lamp circuit input. The light shall be visible when viewing the installed switching device. No other equipment within the controller cabinet shall use a socket, which will accept a switching device.

77-1-21.2 NEMA TS 2 Type 2 Controllers

TS 2, Type 2 NEMA controller with auxiliary equipment will be furnished and installed by the contractor. The controller shall be in a 16-phase frame assembly with auxiliary equipment housed in a cabinet. Solid-state switching devices shall conform to the provisions in Section 77-1.21.1, "Solid-State Switching Devices," of these Special Provisions, and the following:

The controller unit shall meet the most current Caltrans Transportation Electrical Equipment Specifications (TEES) (prior to the bid date of this special provision).

The controller unit shall meet the requirements of NEMA TS-2 2003 V2.06 Actuated Controller Unit Standards. It shall also meet TS 2 Type 2, ATC 5.2b, and NTCIP 1201 and 1202 requirements. The controller shall satisfy the following minimum hardware and feature requirements:

Central Processor Unit (CPU)

- Open architecture platform with standard Linux operating system
- MPC8306 266MHz 16-bit processor
- 256MB FLASH, 256MB DRAM, and 2MB Non-volatile SRAM
- Real-time clock
- Power supply will power the SRAM during power failures

Keyboard and Display

- LCD Display with 16 lines of 40 characters
- 7x4 keypad

Communications

- 2x SDLC ports
- 2x ENET 1 100 Base-T Ethernet ports
- ENET 2 100 Base-T Ethernet port

- 2 USB 2.0 Ports
- 3x Serial connection port
- Unique MAC address assigned by the Institute of Electrical and Electronic Engineers (IEEE)

Controller Housing

- 1 expansion slot for 2070 form factor communication module
- All-metal housing
- NEMA base with NEMA TS 2 Type 2 “A”, “B”, “C”, and Caltrans standard “D” connectors
- NEMA TS 1 small “A” connector
- Controller shall not have VME chassis

Other Hardware

- Controller shall have physical power on/off switch
- The dimensions of the controller shall not exceed 10” H x 11” W x 11” D
- Controller shall be equipped with a minimum 2-amp, 65W triple output switching power supply with minimum MTBF of 270,000 hours

Software

- Controller shall be capable of remote software upgrades without putting the signal in flash
- Controller shall be capable of running multiple different local traffic signal control softwares

77-1-21.3 BLANK

77-1.22 Traffic Signal Controller P Cabinet Specifications

City of Stockton traffic signal cabinet specification shall supersede any applicable parts of the State of California, Department of Transportation Standard Specifications and Standard Plans. This specification shall apply to all controller cabinet types with noted exceptions.

All specifications not covered by these specifications shall conform to the latest Caltrans Standard Specifications and Standard Plans. Traffic signal cabinet shall also comply with NEMA specifications where applicable.

The controller cabinet shall be furnished and installed by the contractor. The controller cabinet shall be equipped with all auxiliary equipment and plug-ins which are capable of operating 8 vehicle phases and 4 pedestrian phases (NEMA TS-2, Type 2). Solid-state switching devices shall conform to the provisions in Section Solid-State Switching Devices," of these Special Provisions and the following:

The cabinet manufacturer shall have pre-approval by the City of Stockton on any cabinet that they propose to provide to the City. Said pre-approval shall have been obtained no less than 30 days prior to the closing date of the bid. The cabinet shall be

completely wired and tested to the 2003 NEMA Traffic Controller Assemblies specification with NTCIP Requirements Version 02.06 (as amended here in). In addition, and at a minimum, the following requirements shall be met:

The cabinet shall be wired for up to a minimum of (32) channels of detection and (4) channels of EVP preemption.

The use of PC boards shall not be allowed except in detector racks & SDLC interface panels.

The use of plug and play modules shall not be allowed, with the exception of detector rack(s).

All cabinet 120VAC wires shall be 18AWG or greater, including controller "A" and MMU "A & B" cables.

The complete cabinet assembly with electronics shall undergo complete input/output function testing by the manufacturer before being released to the City of Stockton.

Cabinet Enclosure

At a minimum the cabinets shall meet the following criteria:

1. It shall have nominal dimensions of 56" high x 44" width x 25.5" depth and meet the footprint dimensions as specified in Section 7.3, Table 7-1 of NEMA TS2 standards for a Type P cabinet. The cabinet base shall have continuously welded interior mounting reinforcement plates with the same anchor bolt hole pattern as the footprint dimensions.
2. Shall be fabricated from 5052-H32 0.125-inch thick aluminum.
3. The cabinet shall be double-flanged where it meets the cabinet door.
4. The top of the cabinet shall be sloped 1" towards the rear to facilitate water runoff. And shall bend at a 90° angle at the front of the cabinet. Lesser slope angles are not allowed.
5. The inside of the cabinet shall utilize C channel rails. (2) Welded on the back wall on 34" center and (4) welded on each side wall on 08" center with 04" between sets. The C channel rails on the back wall shall be 35" in length and start 5" from the bottom of the cabinet interior. The C channel rails on the side walls shall be 48" in length and start 5" from the bottom of the cabinet interior. Adjustable rails are not allowed.
6. The Cabinet shall be supplied with an anodized finish as per the most current California Standard Specification, Sections 86-1.02P, "Enclosures," and 87-1.03Q, "Cabinets" (prior to the bid date of this special provision). Submit alternative design details for review and approval before manufacturing a cabinet.
7. All external fasteners shall be stainless steel. Pop rivets shall not be allowed on any external surface.

8. The door handle shall be ¾" round stock stainless steel bar.
9. The main door shall contain a police door with a conventional police lock. A key shall be provided for both the cabinet lock and the police door lock. The police door shall be recessed into the main door so that the police door is flush with the main door. A closed-cell, neoprene gasket seal shall be bonded to the enclosure doors. A stiffener plate shall be welded across the width of the inside of the main door to prevent flexing. A main door bar stop shall be a two-position, three-point stop that accommodates open-angles at 90, 125, and 150 degrees. A louvered air entrance located at the bottom of the main door shall satisfy NEMA rod entry test requirements for 3R ventilated enclosures. Bearing rollers shall be applied to ends of door latches to discourage metal-on-metal surfaces from rubbing. The lock assembly shall be positioned so handle does not cause interference with key when opening the door.
10. The cabinet shall be equipped with a universal lock bracket capable of accepting a Best™ style lock and a Corbin #2 tumbler series lock. The cabinet shall come equipped with a Corbin #2 lock.
11. The cabinet shall be supplied with three door switches which control the door open status, the cabinet interior lighting circuits and the MMU override circuit.
12. All exterior seams shall be manufactured with a neatly formed continuously weld construction. The weld for the police box door shall be done on the inside of the cabinet door. All welds shall be free from burrs, cracks, blowholes or other irregularities.
13. The fan baffle panel seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
14. The cabinet shall be UL listed.
15. The cabinet shall come with lifting ears affixed to the upper exterior of the cabinet. These ears shall utilize only one bolt for easy reorientation.
16. The cabinet shall come with one (1) dual-ply Dustlock™ Media polyester, disposable air filter; and the filter performance shall conform to listed UL 900 Class 2 and conform to MERV-8 & ASHRAE Standard 52.2-1999. The filter element shall be secured to louvered entrance on the main door with Velcro type mounting on all four edges. The Velcro adhesive shall be rated for high temperatures.
17. The door shall be mounted with a single continuous stainless steel piano hinge that runs the length of the door. The hinge shall be attached via stainless steel tamper resistant bolts.
18. The wired cabinet facility shall use the latest technology applicable and shall be 100% compliant with Section 1605 of the American Recovery and Reinvestment Act of 2009, requiring the use of American iron, steel and manufactured goods. The contract shall provide a "Buy America" certificate.

19. Fire Pre-empt: When a fire pre-empt is specified, either by special provisions or noted on plan with requirement of hardwired interconnect to firehouse, a pre-empt isolation relay panel shall be installed. This panel shall be easily installed without extensive modification to cabinet. If the cabinet is replaced, the modular pre-empt panel shall be easily transferred to a standard City of Stockton cabinet.
20. Vehicle Pre-empt: The vehicle pre-empt shall comply with the Section 77-1.30 “Priority Control System” of this special provisions. The Optical discriminator card shall include the ability to directly sense the green signal indications from traffic signal controller through the use of dedicated sensing circuits and wires connected directly to the field wire termination points in the traffic signal controller cabinet. The discriminator card shall be a plug-in, four (4)-channel, multiple-priority device intended to be installed directly into a card rack, without any modifications to the card rack, located within the traffic signal controller cabinet. The discriminator card shall be able to detect encoded infrared as well as other signals and provide coordinated inputs to the traffic signal controller. The cable, which connects the discriminator card to the auxiliary panel and the harness wires, shall be installed in the traffic signal cabinet prior to shipping the cabinet to the City’s Corporation Yard for testing. Two directions with the same phasing (like; 2-6 and 4-8) shall have separate wiring from traffic signal cabinet to the proper signal poles. The traffic signal cabinet shall be wired such that the two phases do not turn green, at the same time, during vehicle pre-emption in only one direction. The following configuration shall be used for detection.

Channel	Phases	Controller
A	2 & 5	3
B	4 & 7	4
C	6 & 1	5
D	8 & 3	6

A 6-foot Cat5e (Red Color) cable and a SFP-1 Copper 10/100/1000 Mbps RJ45 Small Form-Factor Pluggable module shall be furnished to enable the phase selector to communicate through the Ethernet switch with EVP central software.

21. Railroad Pre-empt: For railroad pre-empt, please refer to plans. The City does not have a standard configuration for railroad pre-empt. Cabinet design engineer shall submit to the City a written schematic of the proposed railroad pre-empt configuration. This schematic design shall be approved by the City prior to the construction of the traffic signal cabinet. If illuminated directional signs required to be installed to restrict turns during railroad pre-emption, sign relay panel shall also be installed as well as pre-empt isolation relay panel in the traffic signal cabinet.

Labels

A permanent printed thermo vinyl, engraved or silk screened label shall be provided for all terminals and sockets. Labels shall be legible and shall not be obstructed by cabinet wiring, panels or cables. All labels shall conform to the designations on the cabinet wiring prints. Labels for all shelf-mounted electronics and equipment shall be on the face of the shelf directly below their placement in the cabinet.

Shelves

Shall come with two (2) double beveled shelves 10" deep that are reinforced welded with V channel, fabricated from 5052-H32 0.125-inch thick aluminum with double flanged edges rolled front to back. Slotted hole shall be inserted every 7" for the purpose of tying off wire bundles.

Cabinet Layout

The shelves shall be populated as follows. The power supply and (2) detector racks shall be placed on the top shelf. The controller and monitor shall be placed on the bottom shelf.

The roll out drawer and LED light shall be mounted under the bottom shelf just left of center.

The display panel shall be mounted on the door.

Load bay shall be mounted on the back wall with 7" of clearance to the bottom of the cabinet.

The detector panel for all field inputs shall be mounted on the lower left wall.

The "D" panel shall be mounted on the left wall just above the detector panel.

The SDLC and power supply interface panels shall be mounted on the left wall between the shelves.

The auxiliary panel for vehicle pre-emption shall be mounted on the left wall under the bottom shelf.

The load resistor panel shall be mounted on the left wall under the 768 panel.

The power panel shall be mounted on the lower right wall.

The 120VAC video power panel shall be mounted above the power panel.

The 120VAC six position power strip shall be mounted on the right wall, between the shelves just under the top shelf.

One 12" x 12" blank panels shall be located on the upper right wall, at the top of the "C" channel.

Ventilating Fans

The cabinet shall be provided with two (2) finger safe fan mounted on the right and left sides of the cabinet plenum, and shall be thermostatically controlled (adjustable between 4-176° Fahrenheit). The safe touch thermostat and power terminal block(s) shall be din rail mounted on right side of cabinet plenum.

Computer Shelf

A slide-out computer shelf 16" length by 12" width by 2" depth shall be installed below the bottom shelf underneath the controller. The shelf shall be mounted just left of center

so that controller cables will not interfere with the operation of the shelf when equipment is installed. The shelf shall have a hinged cover that opens from the front and shall be powder-coated black. It shall be a General Devices Part # VC4080-99-1168. The drawer when fully extended shall hold up to 50lbs.

Main Panel Configuration (Load-Bay)

The design of the panel shall conform to NEMA TS2 Section 5, Terminals and Facilities, unless modified herein. This panel shall be the termination point for the controller unit (CU) MSA, MSB, MSC, (MMU) MSA, MSB cables and field terminal facilities. The terminal and facilities layout shall be arranged in a manner that allows all equipment in the cabinet and all screw terminals to be readily accessible by maintenance personnel.

The load-bay shall be fully wired and meet the following requirements:

- The load-bay shall have the following dimensions; constructed from aluminum with a nominal thickness of 0.125 inches, a maximum height of 19" and a maximum width of 38 inches including attached wiring bundles.
- The entire assembly shall roll down and provide access to all of the back of panel wiring. All solder terminals shall be accessible when the load-bay is rolled down. The assembly shall be able to roll down without requiring other components, cables or switches to be removed.
- The load-bay shall be designed so that all other cabinet screw terminals are accessible without removing cabinet electronics.
- All the controller (CU) and malfunction management (MMU) cables shall be routed through the back of the load-bay so that they will not be subject to damage during load-bay roll down.
- The top of the load-bay panel shall attach directly to Unistrut™ spring nuts without the use of standoffs and spacers.
- The load-bay shall be balanced such that it will not roll down when the Unistrut™ spring nuts are removed, even when fully loaded with BIUs load switches, flasher and flash transfer relays.
- The load-bay facility shall be wired for 16 channels. Load switch(s) 1-8 shall be vehicle phases 1-8; load switch(s) 9-12 shall be pedestrian phases 2, 4, 6 & 8; load switches 13-16 shall be overlaps A, B, C & D. All load switches shall be routed through a flash transfer relay.
- (16) Load sockets spaced on 2" center per NEMA TS2 section 5.3.1.2, Figure 5-2.
- (8) Flash transfer relay sockets.
- (1) Flasher socket.
- All load switches and flasher shall be supported by a bracket extending at least ½ the length of the load switch.
- Wiring for controller A, B & C connectors. All CU wiring shall be soldered to backside of a load bay screw terminal. The screw terminals provide access to all functions of CU cables.
- Wiring for one Type-16 MMU. All MMU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to all functions of the MMU.
- All 24 VDC relays shall have the same base socket, but it shall be different from the 115VAC relays.

- All 115VAC relays shall have the same base socket, but it shall be different from the 24VDC relays. (not applicable to flash transfer relays)
- Shall have a relay that drops +24VDC to load switches when the cabinet is in flash. Relay shall have a test switch for troubleshooting.
- There shall be a wire between the pedestrian yellow field terminals and another terminal on the load bay. The MMU channel 9-12 yellows shall terminate next to said pedestrian yellows terminal.
- The load-bay shall be silkscreened on both sides. Silkscreen shall be numbers and functions on the front side, and numbers only on the back side.
- Field wiring terminations shall be per channel across the bottom of the load-bay. Each channel shall have 3 terminations corresponding to the appropriate vehicle phase Red, Yellow and Green. Default wiring shall be left to right vehicle phases 1-8, pedestrian phases 2, 4, 6 & 8 and overlap channels A, B, C & D following the order of the load switches. Field terminals shall be #10 screw terminal and be rated for 600V.
- All load bay field terminals shall have a copper wire lug, Blackburn part # L35.
- All cable wires shall be terminated. No tie-off of unused terminals will be allowed.
- Shall be 100% manufactured in the United States of America

All wiring shall conform to NEMA TS2 Section 5.2.5 and table 5-1. Conductors shall conform to military specification MIL-W-16878D, Electrical insulated high heat wire, type B. Conductors #14 or larger shall be permitted to be UL type THHN. Main panel wiring shall conform to the following colors and minimum wire sizes:

Vehicle green load switch output	14 gauge brown
Vehicle yellow load switch output	14 gauge yellow
Vehicle red load switch output	14 gauge red
Pedestrian Don't Walk switch	14 gauge orange
Pedestrian Walk switch	14 gauge blue
Pedestrian Clearance load switch	14 gauge yellow
Vehicle green load switch input	22 gauge brown
Vehicle yellow load switch input	22 gauge yellow
Vehicle red load switch input	22 gauge red
Pedestrian Don't Walk input	22 gauge orange
Pedestrian Walk input	22 gauge blue
Pedestrian Clearance input	22 gauge yellow
Logic Ground	18 gauge white with red tracer
+24V DC	18 gauge red with white tracer
+12V DC	18 gauge pink
AC+ Line	14 gauge black
AC- Line	14 gauge white
Earth Ground	16 gauge green
AC line (load bay)	12/14 gauge black
AC neutral (load bay)	12/14 gauge white

Controller A cables	22gauge blue <i>with the exception of power wires (AC+ Black, AC- White & Earth Ground Green) These wires shall be 18AWG</i>
MMU A & B cables	22 gauge orange <i>with the exception of power wires (AC+ Black, AC- White & Earth Ground Green Start Delay Relay Common Black, Normally open Black & Normally Closed Black) These wires shall be 18AWG</i>

Four conductors will supply alternating current (AC) power to the load switch sockets. The load switch sockets shall be supplied 1-4, 5-8, 9-12 & 13-16 by each conductor.

The field terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. Four (4) 12-position terminal blocks shall be provided in a single row across the bottom of the main panel. Spade lugs from internal cabinet wiring are not allowed on field terminal screws. There shall be a second row of four (4) 12-position terminal blocks with screw type #10 above the field terminal blocks. These blocks shall operate the flash program. It shall be changeable from the front of the load-bay.

The power terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. One (1) 12-position terminal blocks shall be provided vertically on the right side of the load bay. The placement of the power terminal block on any other panel shall not be allowed.

All load switches, flasher, and flash transfer relay sockets shall be marked and mounted with screws. Rivets and clip-mounting is unacceptable.

Wire size 16 AWG or smaller at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. All wires shall have lugs or terminal fittings when not soldered. Lap joint/tack on soldering is not acceptable. All soldered connections shall be made with 60/40 solder and non-corrosive, non-conductive flux. All wiring shall be run neatly and shall use mechanical clamps and conductors shall not be spliced between terminations. Cables shall be sleeved in braided nylon mesh and wires shall not be exposed.

All field wiring terminating in the traffic signal controller cabinet shall be fastened to the termination panels with one piece copper solderless/crimless wire lugs. Solderless/crimless lug shall have a maximum wire size capacity of 6.

Load-Bay and Panel Wire Termination

All wires terminated behind the main panel or on the back side of other panels shall be **SOLDERED**. No pressure or solder-less connectors shall be used. Printed circuit boards shall not be allowed on the load bay.

Cabinet Light Assembly

The cabinet shall have an LED lighting fixture with 15 high power LEDs using a cool white color emitting 300lm min @ 12VDC/750mA. The LED shall be a Rodeo Electronics TS-LED-05M02. The LED fixture shall be powered by a Mean Well class 2 power supply LPV-20-12 that shall be mounted on the inside top of the cabinet near the front edge. The cabinet light circuit shall be designed so a second LED fixture will be installed in the cabinet without the need a of a second power supply. It shall be attached under the cabinet drawer so that it remains stationary when drawer is extended. An on/off switch that is turned on when the cabinet door is opened and off when it is closed shall activate the lighting fixture(s) power supply.

Convenience Outlet

The cabinet shall be wired with one (1) convenience outlet with a ground fault interrupter (GFI) and one (1) six position power strip outlet without ground fault interrupters. The ground fault outlet (GFI) shall be mounted on the right side of the cabinet on or near the power panel. The power strip outlet shall be mounted on the right side, between the shelves just below the top shelf. No outlets shall be mounted on the door. The GFI power shall be fed through the auxiliary breaker (CB2). The power strip outlet shall be fed through the ACO breaker (CB3).

Auxiliary Panel

The cabinet shall include an auxiliary switch panel mounted to the interior side of the police panel compartment on the cabinet door. The panel shall be secured to the police panel compartment by (2) screws and shall be hinged at the bottom to allow access to the soldered side of the switches with the use of only a Phillips screwdriver. Both sides of the panel shall be silkscreened. Silk-screening on the backside of the switch panel shall be upside down so that when the panel is opened for maintenance the silk-screening will be right side up.

At a minimum the following switches shall be included;

Controller ON/OFF Switch: There shall be a switch that renders the controller and load-switching devices electrically dead while maintaining flashing operations for purpose of changing the controller or load-switching devices. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Signals ON/OFF Switch: There shall be a switch that renders the field signal displays electrically dead while maintaining controller operation for purpose of monitoring controller operations. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Stop Time Switch: There shall be a 3-position switch labeled “Normal” (up), “Off” (center), and “On” (down). With the switch in the “Normal” position, a stop timing command shall be applied to the controller by the police flash switch or the MMU (Malfunction Management Unit). When the switch is in its “Off” position, stop timing commands shall be removed from the controller. The “On” position

shall cause the controller to stop time. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

MMU Override Switches: There shall be a switch that will allow the MMU to be removed without causing the intersection to go into flashing operation provided the cabinet door is opened. The switch shall be normally off and shall have a flip-up switch cover. This switch cover shall force the switch to the off position when closed. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Technician Flash Switch: There shall be a switch that places the field signal displays in flashing operation while the controller continues to operate. This flash shall have no effect on the operation of the controller or MMU. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Preemption Test Switches: Six (6) preempt inputs shall have momentary pushbutton test switches with red caps. These switches shall be labeled 1, 2, 3, 4, 5 & 6.

Police Panel

Behind the police panel door there shall be switches for use by emergency personnel. The wiring for these switches shall be accessible when the auxiliary panel is open. The following switches shall be included;

Flash Switch: There shall be a switch for the police that puts the cabinet into flashing operations. The switch shall have two positions, "Auto" (up) and "Flash" (down). The "Auto" position shall allow normal signal operation. The "Flash" position shall immediately cause all signal displays to flash as programmed for emergency flash and apply stop time to the controller. When the police flash switch is returned to "Auto", the controller shall restart except when the MMU has commanded flash operation. The effect shall be to disable the police panel switch when the MMU has detected a malfunction and all controller and MMU indications shall be available to the technician regardless of the position of the police flash switch. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Signals ON/OFF Switch: There shall be a switch that renders the field signal displays electrically dead while maintaining controller operation for purpose of monitoring controller operations. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Cables

All wire cable bundles shall be encased in flex or expandable braided sleeving along their entire free length.

All SDLC cables shall be terminated on both ends, securely terminated to the SDLC interface panel with screw type connection and professionally routed in the cabinet interior to easily reach the load bay, controller, malfunction management unit and detector racks. All SDLC connectors shall be fully populated with 15 pins each.

Flashing Operation

All cabinets shall be wired to flash for all vehicle channels. Flashing operation shall alternate between the used vehicle phases 1,4,5,8, pedestrian phases 2, 8, OLA & OLD and 2,3,6,7, pedestrian phases 4, 6, OLB & OLC. Flash programming shall be either red, yellow or no flash simply by changing wires on the front of the load-bay. Cabinet shall be supplied with vehicle and overlap phases programmed to red flash and pedestrian phases to no flash.

Detector Racks

At a minimum, the cabinet shall be wired to accommodate (32) channels of detection. One detector rack shall support (16) channels of loop detection, (1) Buss Interface Unit (BIU) and (4) channel of Emergency Vehicle Pre-emption (EVP) Detection. One detector rack shall support (16) channels of loop detection and one (1) Buss Interface Unit (BIU). Racks shall be capable of using both two channel or four channel detection devices or discriminator cards. The loop cabling shall be connected via a 37 pin DB connector using spring clips. The EVP cable shall be connected via a 24 pin connector using locking latches. The power cable shall be a 6 pin connector. All power wires shall be 18AWG. The addressing of detector racks shall be accomplished via dipswitches mounted to the Printed Circuit Board (PCB). There shall be the capability to turn off the TS2 status to the BIU for the uses of TS1 detector equipment via dipswitches mounted to the PCB. There shall be a 34 pin connector using locking latches that breaks the output from the detector to the input of the BIU, there shall also be +24VDC and logic ground on this connector. All racks shall have space at the bottom front for labeling. All racks shall be designed for horizontal stacking. Separate racks for detection and preemption are not allowed.

Vehicle Pre-emption Auxiliary Interface Panel (AIP)

There shall be an AIP installed in the cabinet. At a minimum it shall be soldered to the load switch green outputs phases 1-8. This panel shall have a protective plastic cover. The panel shall be mounted directly under bottom shelf.

Detection Panel

The detection panel shall support (32) channels of vehicle detection, (4) channels of emergency vehicle preemption detection, (8) channels or pedestrian detection and (8) pedestrian returns on a single panel. The loop wires shall be a 22AWG twisted pair, color coded as follows. Channel one brown, channel two red, channel three orange and channel four yellow. One of the twisted pair wires of all colors shall have a white tracer and land on the second position terminal of each loop. The emergency preempt wires shall be color coded as follows. +24VDC orange, preempt inputs yellow and ground blue. This panel will be mounted on the lower left side of the cabinet.

Controller "D" Panel

The “D” panel shall be a raised panel with all EPAC M type “D” and 2070N type “D” cables. The “D” cable shall be soldered to the backside of the panel. All other wires shall be mounted to the front side. This panel shall be mounted on the left wall of the cabinet above the detector panel.

Power Supply Interface Panel

The power supply interface panel shall include terminations for all the cabinet power supply inputs and outputs. It shall have a protective plastic cover. This panel shall be mounted on the left wall of the cabinet between the shelves.

SDLC Panel

The SDLC panel shall have six 15 socket DB connectors mounted to a PCB. The PCB shall be mounted to an “L” bracket for attaching to cabinet “C” channel. All SDLC cables shall attach with screw type retainers. There shall be one position with latching blocks to mate with latching spring blocks. This panel shall be mounted on the left wall of the cabinet between the shelves.

Video Power Panel

The video power panel shall have five (5) din rail mounted terminal blocks, capable of accommodating 4 size #14 wires in each hole. There shall be two (2) for 120 AC+, two (2) for 120 AC- and one (1) for ground. They shall be labeled respectively. This panel shall be mounted on the right wall of the cabinet above the power panel.

Spare Panels

A sheet metal panel 12” x 12” shall be installed on the upper right wall of the cabinet at the top of the “C” channel.

Supplemental Loads

There shall be a supplemental load panel with (4) 2.5K-ohm, 10-watt panel mount resistor. One side terminated to a (4) position terminal block tied to neutral. The other side terminated to another (4) position terminal block. This block shall be left open for future loading in the cabinet. This panel shall be mounted on the left side of the cabinet below the AIP panel.

Service Surge Suppression

The cabinet shall be equipped with an EDCO model SHP300-10 or approved equivalent surge arrestor mounted on the power panel. Power to all cabinet electronics equipment shall come through this surge suppression circuit.

The power panel shall handle all the power distribution and protection for the cabinet and shall be mounted on the lower right wall of the cabinet. All equipment shall be mounted on a 12” x 17” silkscreened aluminum panel and include at a minimum the following equipment:

- A 30-amp main breaker shall be supplied. This breaker shall supply power to the load bay, load switches and auxiliary panel. It shall also power via the EDCO SHP300-10, the controller, MMU, power supply & detector racks.
- A 15-amp auxiliary breaker shall supply power to the fans, lights and GFI.

- A 15-amp equipment breaker shall supply power to the video power panel and power strip outlet.
- A 60-amp, 125 VAC radio interference line filter.
- A normally open, 50-amp, solid-state relay. The relay shall have a green LED light that is on when energized. (No Mercury Contactors shall be allowed)
- One see-through Plexiglas cover on stand-offs to protect maintenance personnel from AC line voltages. This shall be removable by loosening screws but without removing screws.
- Two (19) position solid aluminum, tin plated neutral buss bar with raised slotted & torque style screw heads.
- One (19) position solid aluminum, tin plated ground buss bar with raised slotted & torque style screw heads.
- Two MOVs shall be terminated on the 120AC in field terminal. One tied between line and ground, the other between neutral and ground.

Display Panel

The display panel shall match the intersection geometrics and traffic signal design phasing. The display panel shall have LED indicator lights, with appropriate colors for each indication represented. The indicators shall be arranged to reflect a typical 8 phase intersection. The panel shall have 3-position detector switches oriented with each vehicle and pedestrian phase indicator light. The switches shall operate as follows; locking call (up), normal operations (middle), momentary call (down). They shall be labeled for each phase. There shall be a door switch to turn on power to the display when the door is open. When the door is closed the switch will remove all power to the indicators. The display LEDs shall be powered by the input side of the load switches. North orientation shall always be in the up direction. All vehicle and pedestrian phases' indicator **lights shall match the intersection layout**. The test switches shall be programmable by connectors on the backside of display panel.

Manuals & Documentation

The cabinet shall be furnished with (3) complete sets of cabinet prints. All cabinet wiring, and layout shall come on (1) E1 size sheet, multiple pages shall not be allowed. Upon request (1) CDROM with AutoCAD v2018 cabinet drawing for the cabinet wiring.

The following auxiliary equipment and plug-ins shall be included in the cabinet unless otherwise is noted.

Malfunction Management Unit (MMU)

The cabinet shall come with a (MMU) Reno A & E 1600 GE or approved equivalent.

Load Switch

The cabinet shall come with (12) load switches. All load switches shall be discrete type and have LED indications for both the input and output side of the load. The load switches shall be Reno LS-200.

Unused Red Jumpers

The cabinet shall be supplied with (16) unused red jumpers. They shall be made out of .063 inches thick aluminum, 2" x 11/16". The U-shaped cut-out shall be exposed aluminum with the rest of the jumper covered with red, heat-shrink tubing insulation.

Flasher

The cabinet shall come with (1) flasher. The flasher shall be discrete type and have LED indications. The flasher shall be Reno FL-200.

Flasher Transfer Relay

The cabinet shall come with (4) heavy duty flash transfer relays. The relays shall be Reno model FR-200.

Bus Interface Unit (BIU)

The cabinet shall come with (2) bus interface units (BIU). These shall meet all the requirements of NEMA TS-2 1988 standards. In addition, all BIUs shall provide separate front panel indicator LED's for DC power status and SDLC Port 1 transmit and receive status. The (BIU)'s shall be Eberle Design, Inc. model BIU700 or approved equivalent.

Power Supply (PS)

The cabinet shall come with a shelf mounted cabinet power supply meeting at minimum TS 2-2003 standards. It shall be a heavy duty device that provides +12VDC at 5 Amps / +24VDC at 2 Amps / 12VAC at .25 Amp, and line frequency reference at 50 mA. The power supply shall provide a separate front panel indicator LED for each of the four outputs. Front panel banana jack test points for 24VDC and logic ground shall also be provided. The power supply shall provide 5A of power and be able to cover the load of four (4) complete detector racks. The (PS) shall be Eberle Design, Inc. (EDI) model PS250 or approved equivalent.

Loop Amplifiers

The cabinet shall come with (8) 4-channel detector amps (Reno ½ width) WS Part # 5620040065 RENO A&E, 4-channel, TS2, 1.12 Wide Faceplate, E/2-1200-SS.

STANDARDS FOR PRE-QUALIFYING TRAFFIC SIGNAL CONTROLLERS

All local controller equipment shall be submitted to City of Stockton Signal Shop for visual inspection and field-testing (field-testing may take up to 3 weeks) prior to bidding. Only those cabinets, controllers, and modules pre-qualified will be allowed to bid.

Prequalification will be based, in part, upon quality of construction, materials used, track density of boards, ability to easily repair boards, overall physical size of controllers, ease of programming, and changes thereto of the total controller for all functions including preemption at each intersection.

CONTROLLER CABINET FOUNDATION

Type P traffic signal controller foundations shall be 18" above finished grade. All edges and corners of foundations shall be rounded or chamfered 1.5 inches radii to prevent chipping. Top surface of foundation shall have smooth or polished surface. No broom finish allowed. This is to facilitate cleaning in the future.

Anchor bolts for the controller cabinet shall extend 1-1/2 inches (plus or minus 1/8 inch) above the top of the foundation. When installing cabinet foundation bolts, install bottom set of nut and washer threaded on the foundation bolts so the nut is embedded in the concrete foundation. The bottom washer shall rest on the top of the concrete foundation. The cabinet then is placed on the washer to prevent direct contact on the concrete foundation. Mastix or plumber's tape shall be all along the base of the cabinet between the washers. After the cabinet is installed on the foundation, silicon sealant shall be used along the outside and inside of the cabinet base to ensure waterproofing. The one inch foundation drain pipe in the back of the cabinet shall be fitted with a union fitting, with the union fitting set just below the top of the foundation grade. A 4" piece of 1" pipe shall be placed in the fitting until the concrete is cured. Then the 1" pipe is removed to ensure the drain is the lowest point of the foundation and will drain properly if it becomes necessary. The foundation shall be located on Minor Street nearest approach unless indicated differently.

WORKMANSHIP - FIELD CONDUCTOR PLACEMENT

Six to eight feet of field wiring, in two to three coils shall be placed in the bottom of the cabinet. These coils shall be neatly bound using tie wraps. Each set of vehicle, pedestrian, pedestrian push button, DLC, common, camera wiring shall be incrementally brought out the coiled bundle depending on its connection point in the cabinet. All conductors or groups of conductors shall be labeled appropriately and only long enough to neatly connect to the load bay or terminal inside the cabinet. The fiber optic cable shall be securely attached to the right side of the cabinet. The connecting ends shall be long enough to be neatly placed along the back, right corner of the cabinet and brought up to the camera modem or Ethernet switch. Labeling of field conductors shall use plastic labeling tie wrap, using permanent black marker compatible with nylon or plastic ty-wrap style.

Full compensation for conforming to the provisions in this section shall be considered as included in the contract price paid for "Traffic Signal and Electrical" and no additional compensation will be allowed therefor.

77-1.23 Luminaires and Numbering Street Lighting poles and traffic signal poles

The Contractor shall furnish and install luminaires with accordance to City of Stockton Standard Drawing R88 through R93 with the exception of the LED luminaires at signalized intersections, which shall be able to deliver 4000K(NW) color and 13,270 lumens at 107 watts.

77-1.23.1 Copper and Wire for Street Lighting

The work shall consist of furnishing and installing street light conductor in conformance with the plans, these Specifications, and as directed by the Engineer.

Copper wire shall be UL approved A.W.G. No. 8 Minimum, 7-strand soft copper, type THWN or THHN with minimum of 3/64 in. polyvinyl chloride insulation, unless otherwise noted. No. 10 in pole may be used.

Full compensation for furnishing all labor, materials, equipment, tools and incidentals

necessary to complete the installation of copper wire as indicated on the plans, in these Special Provisions, and as directed by the Engineer shall be included in the lump sum price paid for "Traffic Signals and Electrical" and no additional compensation shall be allowed therefor.

77-1.24 Fiber Optic Cabling (Existing locations)

General

~~For relocation of controller cabinets, the contractor shall be responsible to perform the relocation and connection of the existing fiber optic cable. It is necessary to maintain communications and protect cabling during construction.~~

~~If the fiber and its associated connectors are damaged due to the contractor's activities, the contractor shall be fully responsible to replace the existing fiber with new. The contractor shall contact AT&T and hire AT&T as sub-contractor to install and test a new fiber cable from the original splice point or termination to an original splice point or termination. Replacement, testing and verification of the new fiber optic cabling shall be done by AT&T. As a subcontractor, all costs incurred by AT&T shall be the responsibility of the contractor.~~

~~The fiber optic cable shall be spliced at the splice vaults if available. The amount of new fiber optic cable slack in splice vaults and the number of new fiber optic cable splices shall be equivalent to the amount of slack and number of splices existing before the damage or as directed by the Engineer.~~

~~The Contractor shall demonstrate that repaired or replaced elements operate in a manner equal to or better than the replaced equipment or as directed by the Engineer. If the Contractor fails to perform required repairs or replacement work, as determined by the Engineer, the City may perform the repair or replacement work and the cost will be deducted from monies due to the Contractor.~~

~~The contractor shall remove all wires first, before removing fiber optic cable from the existing signal cabinet. The connectorized fiber optic cable shall be protected such that none of the pigtailed can be damaged during the pulling through any conduit. The fiber optic cable shall be protected in place in the nearest pull box, in the fiber run, next to the signal cabinet.~~

~~Before any other wires are installed, the existing fiber optic cable shall be re-installed, from nearest pull box, through conduits into the new signal cabinet and re-start communications. The fiber optic cable shall be re-installed in a timely manner in order to minimize the time that the communications are out of service.~~

~~The fiber optic cable shall be secured in the new traffic signal cabinet with Velcro type wrapping. Plastic type wrappings are acceptable.~~

~~The Contractor shall be fully responsible for assembling, installing, testing, and troubleshooting the fiber optic cable system.~~

Testing and Documentation

~~***Fiber optic testing shall only be conducted if an existing fiber optic cable is to be replaced with a new fiber optic cable due to damage done by the contractor.***~~

~~**The contractor shall retain AT&T to conduct, verify and certify all fiber tests and connections. Documentation of all test results (factory and field tests) and fiber run as-builts shall be submitted to the Engineer within two (2) working days after completing the tests.**~~

Testing shall include the tests on elements of the passive fiber optic components:

(1) At the factory:

~~The Manufacturer with the appropriate documentation shall supply verification of the fiber specifications as listed in the Fiber Characteristics Table. After cabling, before shipment but while on the shipping reel, one hundred (100%) percent of all fibers shall be tested for attenuation. Copies of the results shall be (1) maintained on file at the Contractor's, Manufacturer's and Owner's place of business with a file identification number for a minimum of ten (10) years, (2) attached to the cable reel in a waterproof pouch, and (3) submitted to the Contractor and to the Engineer prior to the delivery of the cable to the jobsite.~~

(2) After delivery to the project site but prior to installation:

~~The Cable and reel shall be physically inspected by the Contractor on delivery and one hundred (100%) percent of the fibers shall be tested with the Optical Time Domain reflectometer (OTDR) for attenuation to confirm that the cable meets requirements.~~

~~OTDR testing shall be done at the following points in the system construction:~~

- ~~• At cable delivery (reel test).~~
- ~~• Following cable installation prior to connectorization, termination or splicing.~~
- ~~• End to End following installation of all pigtails, connectors, and termination devices.~~

~~In addition, the final test (post-connectorization test) shall be completed with an optical power meter and light source.~~

~~Test results shall be recorded, dated, compared with the manufacturer factory test results and filed with the factory manufacturer test results accompanying the shipping reel in a weatherproof envelope. Attenuation deviations from the shipping records greater than five (5%) percent shall be brought to the attention of the Engineer in writing. The cable shall not be installed until completion of this test sequence and written approval by the Engineer is received. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the reel of fiber optic cable shall be considered unacceptable and all records corresponding to that reel of cable shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at the Contractor expense. The new reels of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer for approval.~~

(3) After installation but prior to connection to any other portion of the system:

~~After the fiber optic cable has been pulled but before breakout and termination one hundred (100%) percent of all the fibers shall be tested with the OTDR for attenuation. Test results shall be recorded, dated, compared, and filed with the previous copies of the tests. Copies of traces and test results shall be submitted to the Engineer for approval. If the OTDR test results are unsatisfactory, the fiber optic cable segment will be unacceptable. The unsatisfactory segment of cable shall be replaced with a new segment, without additional splices, at the Contractor's expense. The new segment of cable shall then be tested to demonstrate acceptability. The contractor shall also perform end to end attenuation test, utilizing a power meter in field, after installing the cable to establish the integrity and performance of the system and its components. The end-to-end attenuation shall not exceed the sum of the maximum allowable attenuation for the component cable segments, splices, and typical loss for connectors. Nor shall the attenuation from an individual connector exceed the maximum allowable losses. If the fibers in the cable exceed the allowable loss, the Contractor shall take corrective measures to bring the cable's total attenuation below the allowable limit, including replacement of the cable at the Contractor's expense.~~

~~The contractor shall perform all OTDR testing in the presence of the Engineer. The Engineer shall attach their written mark to all test I documentation made by the Contractor at the time of the test. Testing performed by the Contractor and not witnessed by the Engineer shall not be accepted, re-testing will be required.~~

~~The contractor shall verify that the attenuation and optical continuity of each active and spare optical fiber in the cable plant satisfies the specified requirements.~~

~~Attenuation and continuity shall be measured at the operational wavelength of the equipment being used on the link. If the operational wavelength is unknown, the attenuation shall be measured at both 1310nm and 1550nm.~~

~~Testing of fiber links shall be completed in such way, to show the loss of each connector, in the OTDR trace. The tests shall be conducted in both directions. The test shall be performed at both wavelengths (1310 and 1550 nm). The cable shall be tested in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effect on Optical Fiber, Optical Cable, and Passive Fiber Optic Components". Copies of the test results shall be submitted to the Engineer for approval.~~

~~(4) During the final system testing:~~

~~The active components shall be tested after installation. The Contractor shall provide all personnel, equipment, instrumentation and materials necessary to perform all testing. The Engineer shall be notified in writing a minimum of two (2) working days prior to all field tests. The notification shall include the exact location of the system to be tested.~~

~~The fiber optic shall be in one continuous length without factory splices in the fiber. Installation procedures and technical support information shall be furnished at the time of delivery. The change in attenuation at extreme operational temperature for single mode fiber shall not be greater than 0.20dB/km, with 80% percent of the measured values no greater than 0.10dB/km. The single mode fiber measurement is made at 1550nm.~~

The contractor shall also follow the following guidelines for efficient and accurate test results:

- Ensure that the test jumpers (end-to-end attenuation) or test fiber box (OTDR) are of the same fiber core size and connector type as the cable system, e.g., 50/125 μm core test jumpers should be used for testing a 50/125 μm multimode cable.
- Ensure that optical sources are stabilized and have center wavelengths within ± 20 nm of the 850/1300 nm multimode and 1310/1550 nm single-mode nominal wavelengths. In accordance with TIA/EIA-526-14-A, multimode LED sources should have spectral widths from 30-60 nm at 850 nm and 100-140 nm at 1300 nm.
- Ensure that the power meter is calibrated at each of the nominal test wavelengths and traceable to the National Institute of Standards and Technology (NIST) calibration standard.
- Ensure that the power meter and the light source are set to the same wavelength.
- Ensure that all system connectors, adapters, and jumpers are properly cleaned prior to and during measurement.

Full compensation for conforming to the provisions in this section shall be considered as included in the contract price paid for relocation of traffic signal controllers and no additional compensation will be allowed thereof.

77-1.25 Single Mode Fiber Optic Cabling (New Locations)

General

At new locations, certified experienced personnel, with at least 5 years' experience, shall do the installation and connection of any fiber optic cable. The personnel shall be certified by the Fiber Optic Material Personnel. The contractor shall submit the manufacturer's recommended procedure for pulling fiber optic cable at least 20 working days prior to installing cable. Documentation of compliance to this specification shall be provided to the City Traffic Engineering Section of Public Works Department prior to ordering the material. All fiber optic cables shall be tested according to manufacturer's recommended testing procedures and verified by the City prior to final acceptance. The cable shall be new, unused, and of current design and manufacturer. The maximum allowable pulling tension for the cable installation by the contractor shall not exceed 70 percent of the manufacturer's maximum pulling tension.

The fiber cable shall be all-Dielectric, Gel-Free, with stranded loose-tube design with dry water blocking for outdoor duct and aerial installations. The cable shall be comprised of water-swallowable yarns and/or tapes, dielectric strength members, ripcord and a medium

density polyethylene (MDPE) jacket containing carbon black to provide ultraviolet light protection while inhibiting the growth of fungus. The cable shall be fully water blocked using craft-friendly water-swellaable yarns and tapes, making cable access simple and requiring no clean up. **Cables shall contain at least 24 single-mode, or as indicated on the plans, (SM) dual operating window (1310nm and 1550nm) fibers.**

Each fiber shall be distinguishable by means of color-coding in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding." The fiber shall be colored with ultraviolet (UV) curable inks. The contractor shall provide manufacturer's certification that the cable is meeting the functional requirement of Rural Utilities Service (RUS) 7 CFR 1755.900 to 1755.902 and fully comply with ANSI/ICEA S-87-640, *Standard for Optical Fiber Outside Plant (OSP) Communications Cable*. Manufacturer shall be ISO9001 and TL9000 registered. Cable shall have storage temperature range of -40° to 70°C, an installation temperature range of -30° to 70°C and an operating temperature range of -40° to 70°C. The Cable shall have a short-term tensile rating of 2700N. Cable and fiber manufacturer shall be the same company with minimum of 20 years in manufacturing optical fiber cable to demonstrate cable long-term reliable field performance and to ensure the availability of fully integrated technical support.

The fiber cable installed in the traffic signal cabinet, shall be composed of factory pre-connectorized fiber optic SC pig tails and shall be terminated in the LIU wall mount box with either a twelve-(12) port coupler (Simplex) panel or single panel with 2-12 port coupler (Simplex) panels, SC compatible connector. The SC pig tail connectors shall be composed of the same optical fiber glass as used in the optical fiber cable. Contractor shall leave at least 20-foot fiber cable slack in each pull box run, between exiting conduit and entering conduit. The contractor shall also coil 50 lineal feet of fiber cable slack cable in the No. 6 pull box at traffic signal cabinet location, and label the cable. Contractor shall complete the installation of the cable into the controller cabinet and terminate the cable in the LIU.

The fiber optic cable shall consist of, but not limited to, the following components:

- Dielectric central member
- Water-swellaable yarn
- Fiber and water-swellaable yarns (at least 12 fiber per tube)
- Water-swellaable tape
- Dielectric strength members
- Ripcord
- Outer jacket

The buffer tube shall be gel free. The optical fibers shall be contained within loose buffer tubes. The loose buffer tubes shall be stranded around a dielectric central member using the reverse oscillation stranding process. The buffer tubes shall be made of polyethylene (PE). Each buffer tube shall contain a water swellaable yarn for water blocking protection. The buffer tube shall be manufactured to a standard 3.0 mm in size, regardless of fiber count, to reduce the number of required installation and termination tools. Each buffer tubes shall be distinguishable from other buffer tubes in the cable by means of color-coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."

- Dielectric Central Member

The central member which functions as an anti-buckling element to resist temperature and induced stresses, shall be a glass reinforced plastic rod with similar expansion and contraction characteristics as the optical fiber and buffer tubes. The loose buffer tubes shall be stranded around a dielectric central member using the reverse oscillation stranding process.

- Water-Swellable Yarn and Tapes

The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matters. Water swellable yarn(s) shall be applied longitudinally along the central member during stranding. The water swellable tape shall be applied longitudinally over both the inner and outer layer. The tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matters. Two (2) polyester yarn binders shall be applied contra-helicly with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes.

- Dielectric Strength Member

Tensile strength shall be provided by high tensile strength yarns and/or fiberglass which shall be helically stranded evenly around the cable core and shall not adhere to other cable components.

- Ripcord

The cable shall contain at least one ripcord under the jacket for easy sheath removal.

- Outer Jacket

The Cable jacket shall be marked with the manufacturer's name, the number of fiber "SM", month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code (NESC), fiber count, and fiber type. The print color shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5mm. The cable jacket shall be medium density polyethylene (MDPE) jacket containing carbon black to provide ultraviolet light protection while inhibiting the growth of fungus.

77-1.25.1 Rack Mount Enclosure:

The Rack Mountable Connector Housings shall be mountable in an EIA-310 compatible 465 or 592 mm rack. Housings shall be available in several sizes, including 1U, 2U, 3U and 4U. One EIA rack space or panel height (denoted as 1U) is defined as being 44.45 mm in height. The unit shall meet the design requirements of ANSI/TIA/EIA-568 and the polymer compounds flammability requirements of UL 94 V-0. Manufacturer shall be ISO 9001 and TL 9000 registered. The unit shall be available in different sizes to accommodate different port count requirements. Housings shall be manufactured using

16-gauge aluminum or equivalent for structural integrity and shall be finished with a wrinkled black powder coat for durability. Installation fasteners shall be included and shall be black in color.

77-1.25.2 Splice Tray Fiber:

Splice Tray shall be from same manufacturer as the splice closure. Splice only 12 fibers per splice tray and label each tray with a permanent label. The splice tray shall be Wide-Style Splice Tray. Splice Tray shall securely organize and provide physical protection without stress on the fibers for both single-mode and ribbonized fiber splices. Splice Trays shall not induce attenuation of signal at operational wavelengths up to 1550 nm. The splice tray shall be hinged for access to any splices without disturbing other trays.

77-1.25.3 Advanced Splice Closure (ASC):

The closures shall be butt style splice closures with gel sealing technologies for cable termination and hinging splice trays. The closure shall be made with thermoplastic outer materials that withstand temperature and contaminate extremes. The closure shall be designed for use with any cable construction in any environment and for numerous splice applications.

The closure shall accommodate at least 24 SC/UPC connections with 12 SC/UPC connections per tray. The closure shall have at least one oval cable port to terminate at least two cables. The splice closure shall have; easy-to-use dome-to-base clamping with O ring system, and single ended design. The splicing shall be done in accordance to the approved manufacturer's methods, procedures and instructions to ensure warranty compliance.

The splice closure shall have at least six round cable entry ports with multi-cable capacity. This block can be opened and closed repeatedly without the need to remove or replace the gel. With the use of special kits, multiple cables per port shall be installed. The splice trays shall be hinged for access to any splice without disturbing other trays.

The closure shall be pre-assembled case with wide-style splice trays suitable for fiber capacity. To seal the cables entering the enclosure; gel sealing process or wrap around style cable seal shall be used. The closure shall have at least one storage slack tray basket for storing slack fiber. To increase splice capacity the closure can be upgraded by just adding an upgrade kit.

The fiber cable shall be labeled within six inches of the splice closure and 6" from all conducts and sleeves. Laminated labels shall be installed on the external surface of the outside closures. All optical fiber shall be neatly and efficiently dressed into splice tray management and the contractor is to ensure that splices are accessible without damage to the optical fibers or splices. *Contractor shall leave at least 30-foot slack cable on each end of the splice enclosure.* The slack shall be along enough to enable maintenance personnel to perform splicing of the cable in a vehicle located near the controller cabinet. Contractor shall prepare and submit Record Drawings of each splice closure installed, showing each fiber enclosed, fiber color, splices, and unconnected fibers. Record drawings shall be labeled to indicate the splice closure location.

77-1.25.4 Small Lightguide Interconnect Units (LIU) Wall Mount Box

Contractor to install one small Lightguide Interconnect Units (LIU) Wall Mount Box in the traffic signal cabinet at each location shown on the plans.

The Single Panel housings shall be available for cross-connecting or interconnecting purposes. Two (2) single panel units shall be provided. The units shall provide the means for direct connections for up to 2-12 fibers or as indicated on the plans. The units also shall provide means for pigtail splicing within the housing for at least 12 fibers or as indicated on the plans. The Single Panel housings shall accommodate a single Solutions panel. The housings shall have a small footprint and low profile to minimize the amount of occupied space. The dimensions shall not exceed the 6.3" (height) 5.5" (width), and 2" (depth). Manufacturer shall be ISO 9001 and TL 9000 registered.

Housings shall be manufactured using 16-gauge aluminum or equivalent for structural integrity and shall be finished with a wrinkled black powder coat for durability. Assembly hardware and equipment-attaching-machine screws shall be included and shall be black in color. Housing shall include a 0.4" splice holder, which will support up to 12 heat shrink splices. Top and bottom removable cable entry grommets shall be provided to allow for mid-span access and environmental sealing. The housings shall be supplied with pre-drilled holes for surface mounting on the plate in the traffic signal cabinet, but shall have an optional ledge mount bracket available. Each CCH housing should be labeled with Machine labels identifying to/ from destinations and fiber counts. The units shall be installed on a mounting plate in each signal cabinet.

It is acceptable to use a single wall mountable closet housing (WMC) to fit all 24- strand fiber, where the 2 panels cannot be installed.

Laminated labels shall be installed on the external surface of the outside panels.

77-1.25.5 Port Coupler Panels:

The Closet Connector Housing (Simplex) Panels shall be in 12-fiber versions for use. The panels shall be able to be used with field-installable connectors or in applications where the pre-terminated cables are routed directly from the equipment to the interconnect hardware. The 12-fiber versions shall include in-line SC-SC Compatible Connector.

The Closet Connector Housing Panels shall be designed to accommodate applications requiring specified labeling and connector identification. Each CCH housing should be labeled with Machine labels identifying to/ from destinations and fiber counts.

The panel shall be attached with two push-pull latches to allow quick installation and removal. Blank connector panels shall be available to fill unused space within the housings. The blank connector panel shall be attached with at least two push-pull latches to allow quick installation and removal. The blank panels shall be manufactured from injection-molded polycarbonate. Panels shall be manufactured from 16-gauge cold rolled steel or injection-molded polycarbonate for structural integrity.

77-1.25.6 Single Mode Fiber Patch Cables SC-SC, ST-SC:

Patch Cord connectors shall be measured for insertion loss with the following values for each connector: typical of 0.1 dB and maximum of 0.5 dB and guaranteed reflectance of = -55 dB for UPC. Manufacturer shall be ISO 9001 and TL 9000 registered. Available connectors shall be single-mode SC, ST® Compatible Connector. Patch Cord shall contain standard single-mode fiber and shall comply with TIA/EIA-568-B.3 and applicable TIA/EIA-604 document. Patch Cord jacket color shall be yellow. Patch Cord shall be available in different lengths. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing optical fiber patch cords. Manufacturer shall manufacture both cable, fiber, and the connectors.

At the signalized intersection, in the Traffic Signal Cabinet

- Provide two (2) 1m patch cables SC-SC (Duplex) jumpers to connect from fiber housing to the switch.
- Provide two (2) 1m patch cable ST-SC (Duplex) jumpers for video connections to the video/data modem.

At Fiber Hub locations/City Hall (TMC)

- Provide as many 2m/10m patch cable SC-SC (Duplex) jumpers as fiber strands going in the Fiber Hub/City Hall (TMC).

Notes: Connector codes available must be inserted into the first four digits and are the following:

72 = SC Duplex, 61 = ST Compatible Ultra PC.

77-1.25.7 Fiber Optic Conduits

Conduit shall conform to the provisions in Sections 86-1.02B, "Conduit and Accessories" and 87-1.03B, "Conduit Installation" of the Caltrans Specifications and these Special Provisions.

All Fiber Optic Conduits shall be 2 ½" Poly Vinyl Chloride (PVC) or HDPE (Orange color), Schedule 80 with rigid steel sweeps. The HDPE conduit shall be capable of being coiled on reels in continuous lengths and uncoiled for installation without affecting its properties or performance. With the exception for bends to and from pull boxes and foundations, the conduit shall run straight and true so that cable pulling forces are minimized. The conduit shall have smooth outer wall and smooth inner wall. Intermediate pull boxes shall be installed every 500 feet.

Conduit sweeps into No. 6 pull boxes on fiber optic interconnect runs shall enter/exit, with rigid sweeps, at 45 degrees (in vertical plane). Plastic pulling bells shall be installed on all conduit ends before conductors are pulled through the conduits.

After fiber has been installed, the ends of conduits terminating in pull boxes and/or controller cabinets will be sealed with an approved type of sealing compound. Refer to the City of Stockton Standard Drawing No.R87 for conduit/pull box details.

Refer to City of Stockton Standard Plan Drawing No. R37 for trench width and depth. All conduits shall be installed below the existing AC pavement regardless of the depth of the existing AC pavement. All conduits shall be installed at a minimum depth of thirty (30) inches (top of conduit to the finish grade).

All excavated areas in the street or sidewalk shall be completely backfilled or covered at the end of each working day and approved by the Engineer.

Where existing conduits to be used, as directed by the Engineer, the existing conduit shall be cleaned and both old and new cables shall be pulled into the existing conduit as a unit per the Caltrans Specifications in Section 87-1.03F, "Conductors and Cable Installations".

The 2.0" rigid metal conduit between #6E pull box and the controller cabinet shall have 90-degree sweep and large radius bend. Sweeps shall be at least 24 inches below finished grade, unless approved by engineer. A pulling bell shall be installed at the end of each conduit.

All fiber optic interconnect conduits with fiber cable shall include one 1250lbf detectable Muletape with 22 AWG wire. A detectable Muletape shall be installed after Fiber Optic cable installation for future detection.

77-1.25.8 Colored Controlled Density Fill (CDF)

The controlled density fill for the installations of fiber optic conduits shall be a red color to distinguish the concrete backfill from other concrete and soil. The concrete shall be pigmented by the addition of commercial quality cement pigment to the concrete mix.

The red concrete pigment shall be LM Scofield Company; Orange Chromix Colorant; or Davis Colors; or accepted equivalent. A minimum of 5 lbs. of red tint pigment shall be used per cubic yard of the CDF mix.

77-1.25.9 Fiber Optic Pull Boxes

Pull boxes shall conform to the provisions in Sections 86-1.02C "Pull Boxes" and 87-1.03C "Installation of Pull Boxes" of the Caltrans Specifications and these Special Provisions.

When a pull box is subjected to vehicular traffic load, the cover shall be steel embossed with a non-skid pattern.

Pull boxes shall be placed at same elevation as adjacent standard base, service cabinet base or signal controller cabinet base if not an existing or future sidewalk area and elevation is not shown on plans. Pull boxes shall be five feet (5') from base or as shown on the plans. Pull boxes in existing or future sidewalk areas shall be placed at sidewalk elevation. The pull box elevation for pull boxes installed in median areas shall match the slope of the two adjacent curbs. The pull box elevation for pull boxes installed in planting areas adjacent to sidewalk or sidewalk area shall be at sidewalk grade. Pull boxes shall not be located within the limits of wheelchair ramps.

When pull boxes are placed in dirt and planting areas, a concrete collar shall be constructed around the pull box. The concrete collar shall be a minimum 12 inch concrete collar by 4 inch thick and at least 4 inches along the sides of the pull box to the bottom edge. The top of the pull box shall match slope of the adjacent top of curb. The surface elevation of the collar shall match the surface elevation of the pull box and slope away from the pull box at a rate of 1:50 (2%) slope.

The Contractor shall clean all existing pull boxes entered for installation of conduit of all dirt and debris. All pull box lids damaged by Contractor operations shall be replaced at his/her expense. The wiring in these pull boxes shall be neatly bundled, recoiled and reinstalled in the box. Where existing pull boxes are removed and replaced with new larger boxes the existing conduits shall be cut back. When the conduits are cut, the existing conductors must either be removed or well protected. The ends of the cut conduits must have bushings placed on them.

Grout in bottom of pull boxes will not be required. Pull boxes shall be set on 6 inches of crushed rock for drainage. The conduits in the pull boxes shall be placed 2" above the crushed rock.

All pull boxes on fiber optic interconnect runs shall be # 6 unless otherwise noted on the plans. All conduit sweeps into No. 6 pull boxes on fiber optic interconnect runs shall be 45 degrees. Contractor shall leave at least 20-foot fiber cable slack in each pull box run, between exiting conduit and entering conduit. All pull boxes shall have lids embossed with "INTERCONNECT".

A State Standard Number 6E pull box with extension (17" x 30" x variable depth (inside dimensions)) shall be installed adjacent to the traffic controller cabinet for fiber optic interconnect cable. The seam between pull box and extension shall be grouted. Contractor shall leave at least 50-foot fiber cable slack in pull box, between exiting conduit and entering conduit.

77-1.25.10 Testing and Documentation:

The contractor shall retain AT&T or approved fiber optic contractor to verify and certify all fiber tests and connections. Documentation of all test's results (factory and field tests) and fiber run as-builts shall be submitted to the Engineer within two (2) working days after completing the tests.

Testing shall include the tests on elements of the passive fiber optic components:

(1) The factory:

The Manufacturer with the appropriate documentation shall supply verification of the fiber specifications as listed in the Fiber Characteristics Table. After cabling, before shipment but while on the shipping reel, one hundred (100%) percent of all fibers shall be tested for attenuation. Copies of the results shall be (1) maintained on file at the Contractor's, Manufacturer's and Owner's place of business with a file identification number for a minimum of ten (10) years, (2) attached to the cable

reel in a waterproof pouch, and (3) submitted to the Contractor and to the Engineer prior to the delivery of the cable to the jobsite.

(2) After delivery to the project site but prior to installation:

The Cable and reel shall be physically inspected by the Contractor on delivery and one hundred (100%) percent of the fibers shall be tested with the Optical Time Domain reflectometer (OTDR) for attenuation to confirm that the cable meets requirements.

OTDR testing shall be done at the following points in the system construction:

- At cable delivery (reel test).
- Following cable installation prior to connectorization, termination or splicing.
- End to End following installation of all pigtails, connectors, and termination devices.

In addition, the final test (post-connectorization test) shall be completed with an optical power meter and light source.

Test results shall be recorded, dated, compared with the manufacturer factory test results and filed with the factory manufacturer test results accompanying the shipping reel in a weatherproof envelope. Attenuation deviations from the shipping records greater than five (5%) percent shall be brought to the attention of the Engineer in writing. The cable shall not be installed until completion of this test sequence and written approval by the Engineer is received. Copies of traces and test results shall be submitted to the Engineer. If the OTDR test results are unsatisfactory, the reel of fiber optic cable shall be considered unacceptable and all records corresponding to that reel of cable shall be marked accordingly. The unsatisfactory reels of cable shall be replaced with new reels of cable at the Contractor expense. The new reels of cable shall then be tested to demonstrate acceptability. Copies of the test results shall be submitted to the Engineer for approval.

(3) After installation but prior to connection to any other portion of the system:

After the fiber optic cable has been pulled but before breakout and termination one hundred (100%) percent of all the fibers shall be tested with the OTDR for attenuation. Test results shall be recorded, dated, compared, and filed with the previous copies of the tests. Copies of traces and test results shall be submitted to the Engineer for approval. If the OTDR test results are unsatisfactory, the fiber optic cable segment will be unacceptable. The unsatisfactory segment of cable shall be replaced with a new segment, without additional splices, at the Contractor's expense. The new segment of cable shall then be tested to demonstrate acceptability. The contractor shall also perform end to end attenuation test, utilizing a power meter in field, after installing the cable to establish the integrity and performance of the system and its components. The end-to-end attenuation shall not exceed the sum of the maximum allowable attenuation for the component cable segments, splices, and typical loss for

connectors. Nor shall the attenuation from an individual connector exceed the maximum allowable losses. If the fibers in the cable exceed the allowable loss, the Contractor shall take corrective measures to bring the cable's total attenuation below the allowable limit, including replacement of the cable at the Contractor's expense.

The Contractor shall perform all OTDR testing in the presence of the Engineer. The Engineer shall attach their written mark to all test I documentation made by the Contractor at the time of the test. Testing performed by the Contractor and not witnessed by the Engineer shall not be accepted, re-testing will be required.

The Contractor shall verify that the attenuation and optical continuity of each active and spare optical fiber in the cable plant satisfies the specified requirements.

Attenuation and continuity shall be measured at the operational wavelength of the equipment being used on the link. If the operational wavelength is unknown, the attenuation shall be measured at both 1310nm and 1550nm.

Testing of fiber links shall be completed in such way, to show the loss of each connector, in the OTDR trace. The tests shall be conducted in both directions. The test shall be performed at both wavelengths (1310 and 1550 nm). The cable shall be tested in accordance with EIA-455-3A (FOTP-3), "Procedure to Measure Temperature Cycling Effect on Optical Fiber, Optical Cable, and Passive Fiber Optic Components". Copies of the test results shall be submitted to the Engineer for approval.

(4) During the final system testing:

The active components shall be tested after installation. The Contractor shall provide all personnel, equipment, instrumentation and materials necessary to perform all testing. The Engineer shall be notified in writing a minimum of two (2) working days prior to all field tests. The notification shall include the exact location of the system to be tested.

The fiber optic shall be in one continuous length without factory splices in the fiber. Installation procedures and technical support information shall be furnished at the time of delivery. The change in attenuation at extreme operational temperature for singlemode fiber shall not be greater than 0.20dB/km, with 80% percent of the measured values no greater than 0.10dB/km. The singlemode fiber measurement is made at 1550nm.

The contractor shall also follow the following guidelines for efficient and accurate test results:

- Ensure that the test jumpers (end-to-end attenuation) or test fiber box (OTDR) are of the same fiber core size and connector type as the cable system, e.g., 50/125 μm core test jumpers should be used for testing a 50/125 μm multimode cable.

- Ensure that optical sources are stabilized and have center wavelengths within ± 20 nm of the 850/1300 nm multimode and 1310/1550 nm single-mode nominal wavelengths. In accordance with TIA/EIA-526-14-A, multimode LED sources should have spectral widths from 30-60 nm at 850 nm and 100-140 nm at 1300 nm.
- Ensure that the power meter is calibrated at each of the nominal test wavelengths and traceable to the National Institute of Standards and Technology (NIST) calibration standard.
- Ensure that the power meter and the light source are set to the same wavelength.
- Ensure that all system connectors, adapters, and jumpers are properly cleaned prior to and during measurement.

77-1.25.11 Warning Tape:

Warning tape shall be provided and placed in the trench over conduits containing fiber optic cable as shown on the plans. The warning tape shall be four (4") inches wide with bold printed black letters of approximately seventy-five (75") inches on bright orange color background, and contain the printed warning "CAUTION BURIED FIBER OPTIC CABLE" repeated at approximately thirty (30") inches intervals.

The printed warning shall be non-erasable and shall be rated to last with the tape for a minimum of forty (40) years.

The construction of the warning tape shall be such that it will not delaminate when it is wet. It shall be resistant to insects, acid, alkaline and other corrosive elements in the soil. It shall have a minimum of 120 lb tensile strength per four (4") wide strip and shall have a minimum of seven hundred (700%) percent elongation before breakage. The warning tape shall be the detectable type with a contiguous conductor in the form of a copper wire or aluminized foil, encased in a protective plastic jacket. The aluminized foil shall be approximately 0.01" (inch) thick. Separate rolls of the warning tape shall be electrically connected by corrosion resistant clips or soldering. The ends of warning tape shall extend into pull boxes and splice vaults a minimum of twenty-four (24") inches for future connection to a warning signal device. The continuity and detectability of the warning tape, for the entire conduit run, shall be demonstrated prior to and again after backfilling each trench to the satisfaction of the Engineer.

77-1.26 Street Name Signs

The Contractor shall provide and install street name signs as shown on the plans and in accordance with these Special Provisions. Contractor shall supply sign brackets and all necessary hardware to install signs. Payment of furnishing brackets, hardware, and installing street name signs shall be included in the lump sum bid item for "Traffic Signal and Electrical".

The contractor shall submit a street name sign design as part of the submittals to be approved for conformance prior to ordering the street name signs. Street name sign block numbers shall be installed on the lower right hand side of each street name sign. The street name sign shall be installed in conformance with the City of Stockton Standard Drawings number R94. The street name sign shall be type, at least, HIP series 3900 sheeting. The street name sign bracket shall be double banded on mast arm.

R3-4 (No U-Turn) mast arm sign shall be 36"x36".

R73-2 (Left-Turn & U-Turn) mast arm sign shall be 36"x36".

77-1.27 Traffic Signal Controller Communications and CCTV System:

77-1.27.1 Fiber Optic Ethernet Switches

The contractor shall supply and install the following devices one in the field controller cabinets and one in the City's Traffic Management Center (TMC) to establish communication between devices such as the traffic signal controller, IP based camera, and their associated central servers in TMC. Each Fiber Optic Ethernet Switch shall consist of the following:

GENERAL SPECIFICATIONS

The Ethernet data switch shall be environmentally hardened Ethernet 12-port managed switch, supports 10/100/1000Mbps (one for field and one for central control center installation), with manufacturer provided lifetime warranty.

The module shall support transmission utilizing Category 5 cable or better, multimode, or single-mode fiber. The module shall support the Ethernet data IEEE 802.3 protocol using Auto-negotiating and Auto-MDI/MDI-X features. The module shall feature 8 (eight) 10/100/1000BASE-T(X) RJ-45 ports, each capable of 30 Watt PoE, and 4 (four) 100/1000BASE-X Small Form-factor Pluggable (SFP) ports. The SFP module shall require no in-field electrical or optical adjustments or in-line attenuators to ease installation. The module shall provide power, link speed, and fiber port status indicating LED's for monitoring proper system operation. The modules shall provide automatic re-settable solid-state current limiters on each module to reduce the chance of a single point failure of the system. The module shall have dual redundant power supply connections to minimize single point failure. The module shall provide a serial connection for local management of the device. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure.

1. DATA SPECIFICATIONS

- a) Data Interface: Ethernet IEEE802.3
- b) Data Rate: 10/100/1000 Mbps
- c) Data Inputs/Outputs: 12
- d) Operation Mode: Half or Full Duplex
- e) Max VLANs: 256
- f) 24 Gbps switching bandwidth
- g) MAC table capable of storing 8000 MAC addresses

h) 16 Mb packet buffer

2. OPTICAL SPECIFICATIONS

- a) Number of Optical ports: 4 SFP-dependent
- b) Number of Fibers Required: 1 or 2, SFP-dependent
- c) Optical Wavelength: 850, 1310 or 1550 nm, SFP-dependent
- d) Optical Power Budget: SFP-dependent
- e) Maximum Distance: up to 120 km (70 mi) single mode, SFP-dependent

3. STATUS INDICATORS

- a) Power
- b) Per Port: Link/Activity
- c) Per Port: PoE Status
- d) Ring Status

4. CONNECTORS

- a) Optical: LC or SC, SFP-dependent
- b) Data: RJ-45
- c) Console: RJ-45

5. ELECTRICAL SPECIFICATIONS

- a) Power: 12 VDC
- b) Reverse polarity protected
- c) Overload current protected
- d) Circuit Board: UL 94 flame rated and meets all IPC standards.
- e) PoE: 30 W per port, 240 W budget

6. ENVIRONMENTAL SPECIFICATIONS

- a) MTBF: >100,000 Hours
- b) Operating Temp: -40° C to +75° C
- c) Storage Temp: -40° C to +85° C
- d) Relative Humidity: 5% to 97% (non-condensing).

7. MOUNTING SPECIFICATIONS

Shall be mountable on wall, shelf, DIN rail

8. REGULATORY AGENCIES/APPROVALS AND LISTINGS

- a) Underwriters Laboratory (UL) Listing
- b) Federal Communication Commission (FCC) Part 15 compliant
- c) NEMA TS1/TS2 Certified
- d) CE marked
- e) Restriction of Hazardous Substances (RoHS) compliant
- f) IP30 rating
- g) "Buy America" Compliant

9. SMALL FORM-FACTOR PLUGGABLE (SFP) MODULE

- a) All SFPs should come with manufacturer provided lifetime warranty.

- b) Temperature Requirements: Products shall operate in an environment with an ambient temperature range of 0° F to +150° F without the assistance of fan-forced cooling. The modules shall have an MTBF (Mean time between failures) of >100,000 hours.
- c) Provide MSA Compliant one fiber SC Small Form-Factor Pluggable (SFP) Optical Device. The devices shall utilize 1000fx, 1310/1550 nm optics capable of simultaneous bi-directional signal transmission on one single mode optical fiber. The SFPs shall have the same transmitting sensitivities with the matching SFPs upstream or downstream. The SFP modules shall have different wavelengths and optical power to offer distances from 300 meters to 120 kilometers. The module shall require no in-field electrical or optical adjustments or in-line attenuators to ease installation. The module shall be UL listed. The circuit board shall be UL 94 flame rated and meet all IPC standards. Housing shall be of all metal construction. All LED indicators and both electrical and mechanical connections shall be identified with silk-screened labels. The Contractor shall install one 1000fx, 1550nm, single-mode SC fiber SFP and one 1000fx, 1310nm, single-mode SC fiber SFP into the 12-port Ethernet switch for field installation and deliver one each of the 1550nm and 1310nm SFPs to the City for central installation.
- d) Copper 10/100/1000 Mbps RJ45 SFP module. The module shall require no in-field electrical or optical adjustments or in-line attenuators to ease installation. The module shall be UL listed. The circuit board shall be UL 94 flame rated and meet all IPC standards. Housing shall be of all metal construction. All LED indicators and both electrical and mechanical connections shall be identified with silk-screened labels. Housing shall be of all metal construction. The Contractor shall deliver all copper SFPs to the City.

ACCESSORIES

- a) 6-foot Cat5e cable (with yellow skin) to connect the traffic signal controller to the 12-port Ethernet switch.
- b) 6-foot Cat5e cable (with red skin) to connect the EVP phase selector to the 12-port Ethernet switch.
- c) 6-foot Cat5e cable (with gray skin) to connect the video detection CCU to the 12-port Ethernet switch
- d) 6-foot Cat5e cable (with blue skin) to connect an additional IP device to the 12-port Ethernet switch
- e) Associated switch mounting hardware
- f) 240 Watt @ 48 Volt DIN rail mounted power supply for PoE
- g) Other accessories as required by the manufacturer.

After submitting the Ethernet switch and SFP submittals, under the direction of the Engineer, the Contractor may be required to demonstrate that the proposed switch and SFPs adhere to the requirements of these technical specifications. The demonstration shall take place at a City signalized intersection and at City Hall. The demonstration shall show that the proposed switch and SFPs can transmit and receive data between testing traffic signal controller and City's existing centralized traffic signal servers, and between other traffic signal controllers in the same communication channel and network. The switch and SFP modules used in the demonstration shall be the exact make and model of the modules that Contractor proposes to install in the field. Satisfactory demonstration of the switch and modules functionality shall be determined by the Engineer. The Contractor shall be responsible arranging the demonstration at no additional charge to the City nor to the project.

77-1.27.2 Monitoring Camera Cabling (General)

CAT5e RJ45 10/100/1000Base-TX Ethernet (High Power-over-Ethernet) or PoE+ (IEEE 802.3at, class 4 standard) 21-30 VAC, 50/60 Hz, outdoor, shielded cable with integrated ESD drain wire and anti-crosstalk divider and secondary shielding. RJ45 connectors shall provide protections against ESD attacks and Ethernet hardware damages,

Power cable shall be A11403-BWG (water and sun resistant, 3 #14 AWG, white/green/black, UL Type TC 600V, NEC Type TFN Conductors, IEEE 1202/CSA FT4, IEEE 383, UL Subject 1277, and OSHA acceptable) or accepted equivalent.

77-1.27.3 Traffic Monitoring Camera Conductors Field Installation (General)

The installation of the wiring will require that a hole be drilled into the camera supporting structure for all the camera installations. Prior to drilling this hole the existing wiring inside the pole or mast arm shall be removed or protected such that it is not damage by the drilling operation. The edges of the drilled hole shall be smoothed. The Contractor shall install a watertight gland nut (or grommet) in this hole that securely holds the wiring. All cables shall be:

- Installed without damaging the conductors or insulation
- Installed without kinks
- Handled in accordance with manufacturers specifications and recommended bending radius
- Run continuously between terminations without splices
- Installed with sufficient slack for equipment movement
- Neatly tagged at the cabinet to indicate which camera it serves
- Rated for outdoor use and resistant to water and UV radiation
- Have a watertight, strain relieved plug type connection to the camera housing

The Contractor shall make all connections of this wiring to the camera assembly, the video transmission device, and power.

77-1.27.4 High Speed Dome Pan/Tilt/Zoom Traffic Monitoring Camera

The high speed camera unit shall be 1080p HD Outdoor Day/Night Network PTZ Dome Camera that delivers 1920 x 1080 resolution video with up to 30x optical zoom and

providing a 360 degree viewing field. It comes equipped with an outdoor pendant housing. It features complete network-based control of all dome functionality, including pan/tilt/zoom operation, presets, tours, and alarms, as well as web-based configuration of all dome settings. It also provides direct network video streaming using H.264 compression and bandwidth throttling to efficiently manage bandwidth and storage requirements. Equipment shall include all mounting adaptor (pole mount, and/or luminaire arm mount), pendant arm and power supply, camera unit, data cable, power cable, to make the installation complete and operational with the existing City traffic management's video system.

The camera shall be fully compatible and shall communicate with the City's existing Bosch' Allegiant Microprocessor Based Switcher/Control System LTC 8903/60, without requiring modification or re-configuration after being decoded. After submitting the camera submittal, under the direction of the Engineer, the Contractor may be required to demonstrate that the proposed camera adheres to the requirements of these technical specifications. The demonstration shall take place at a City facility and show that the camera is compatible with the existing camera switch, and that the camera can be controlled from the City's central camera control location. The camera used in the demonstration shall be the exact make and model, using the exact software, of the camera that Contractor proposes to install in the field. Satisfactory demonstration of camera functionality shall be determined by the Engineer. The Contractor shall be responsible arranging the demonstration at no additional charge to the City nor to the project.

The proposed camera shall have features and functionality that meet or exceed the following specifications:

1. The mounting hardware shall include a mast mount option to be installed on traffic signal poles, as well as a pipe mount option to be installed on luminaire arms.
2. If it is mast mounted, the arm mount assembly shall provide minimum 14" clearance between the edge of the pole and the center of the camera.
3. The camera and its housing's weight shall not exceed 7 lbs.
4. Camera shall have a minimum of 50 preset scenes, which shall be presentable in a preset tour.
5. Camera assembly shall be housed in an IP66 enclosure.
6. Shall have at a 30x Zoom, and 12x Digital Zoom. The 12x digital zoom shall not cause the image to become unrecognizable.
7. The effective pixel shall be 1900x1040(2.0 MP).
8. Shall have internal heater that is powered through RJ45 10/100Base-TX Ethernet (High Power-over-Ethernet) 21-30 VAC, 50/60 Hz.
9. The camera shall have a wide dynamic range of 120 dB and signal-to noise ratio greater than 50dB.
10. The camera shall be capable of the following preset speeds:
 - a. Pan – 360 degrees per second
 - b. Tilt – 250 degrees per second
11. The camera shall be capable of automatically pivoting the sensor to follow a target that moves underneath the camera.
12. Record and play back minimum two 30-minutes tours.

13. The lens shall return to a preset scene after a user defined idling time.
14. The pan, tilt, and zoom shall be able to function simultaneously for manually tracking speeding objects.
15. The camera shall be able to be configured remotely without needing to access any part of the camera equipment locally.

The camera shall meet or exceed the following technical specifications:

Construction

Housing:	Aluminum
Bubble:	Acrylic (high-resolution), clear
Installation Environment:	IP66, NEMA 4X
Operating Temperature:	Maximum 130 F Minimum 15 F

Electrical

Input Voltage:	21 to 30 VAC, 50/60 Hz
Power Consumption:	60W (max)
Control Data:	RJ45 10/100Base-TX Ethernet
Video:	H.264 (ISO/IEC 14496-10), MJPEG, JPEG
Audio:	Available

Testing and Final Acceptance

Make proper adjustments to video system devices to for correct operation in accordance with manufacturer’s instructions.

Make any adjustment of camera settings that are required in order to meet the operations needs of the City.

Demonstrate upon final inspection that the video management system and devices function properly when controlled from Central.

The Contractor shall be fully responsible for purchasing, assembling, installing, testing, and troubleshooting the camera system and all the corresponding camera mounting hardware at each installation location.

77-1.27.5 High Speed Dome Pan/Tilt/Zoom Camera Installation

The Contractor shall obtain an IP address from the City and configure the camera. The Contractor shall install and fully adjust the camera with the associated lens, communication addressing, power supplies, housings, and all-necessary cabling, etc., to make the assembly operational. The Contractor shall firmly attach the dome system to the assigned poles as shown on the Plans. The Contractor shall exercise care to tighten

the camera mount within the torque limits specified by the camera manufacturer.

The Contractor shall properly terminate all of the electrical cables to the camera and firmly attach them. The Contractor shall dress and secure the electrical cables inside the dome enclosure and traffic signal cabinet so that they do not interfere with the closing of the cabinet, with the fan, or with any other moving part.

Cameras and other video sources where possible, shall use the electrical power supply 60 Hz signal for synchronization. When cameras are initially installed, the camera shall be in a position where its view of the roadway will not be obstructed by the pole it is mounted on. At a 4-leg intersection, the camera shall be capable of seeing all four legs without its view being blocked by the signal pole.

After all cameras are installed and central equipment is operational, the Contractor shall arrange an interactive session with the Engineer to fine-tune any adjustments to the camera that require a technician in the field. This session shall enable the Engineer to observe the image at the control room while being in verbal communication with the Contractor at the camera. The Contractor shall provide a camera license from Verint to the City.

77-1.28 Payment

Payment for furnishing and installing traffic signals, street lighting, and interconnect shall conform to the provisions in Section 9, "Payment," of the Caltrans Specifications and these Special Provisions.

Full compensation for furnishing the labor, materials, tools, equipment, including installing PTZ cameras, video and data modems, hardware, conduits, and wiring, complete in place as shown on the plans and as specified in the Standard Specifications, these Special Provisions, and as directed by the Engineer, shall be considered as included in the contract lump sum price paid for "Traffic Signal and Electrical" and no additional compensation will be allowed therefor.

Hauling and stockpiling of salvaged material off the right-of-way and delivered to the City Corporation Yard, 1465 South Lincoln Street, will be considered as included in the contract prices paid for the various items of work, and no additional payment will be allowed therefor.

77-1.29 Removing, Reinstalling or Salvaging Electrical Equipment

Removing, reinstalling or salvaging electrical equipment shall conform to the provisions in 87-21.03A "General" and 87-21.03D "Removing Existing Electrical Systems" of the Caltrans Specifications and these Special Provisions.

Existing facilities that are removed (i.e., streetlights, electroliers, frames, grates, covers, roadside signs, etc.) shall be salvageable wherever shown on the plans and as determined by the Engineer. Equipment shall be tagged with intersection name from which it was removed.

All equipment to be salvaged shall be handled as follows: All signal equipment (signal heads, pedestrian heads, push buttons, etc.) shall be removed from the poles and stacked on pallets. This includes signal hardware, conductors, and terminal compartments. The equipment shall be secured on the pallets and delivered to Corporation Yard. All poles shall be salvaged to the storage yard on Daggett Road. Contact the City's Operation and Maintenance at (209) -937-8341, giving 3 days advanced notice prior to delivery. Staff will direct contractor to Daggett Road yard and where to leave signal equipment in the Corp Yard.

All conductors shall be removed from abandoned conduits. Otherwise, removed items shall become the property of the Contractor and shall be disposed of as provided in Section 14 and Section 5-1.20B(4) of the Caltrans Specifications and these Special provisions.

The following material shall be salvage to the contractor;

- 8" traffic signal heads
- Mast arm signal poles
- HP luminaire fixtures
- Traffic signal wires

The following materials shall be salvage to the City;

- Pedestrian signal indications
- Pedestrian push buttons
- 12" traffic signal heads
- Luminaire mast arm and the LED fixture
- 1-B traffic signal poles with ornamental flange cover

77-1.30 Priority Control System

The contractor shall be fully responsible for purchasing, assembling, installing, testing, and troubleshooting the vehicle pre-emption system. The priority system shall receive and store all information in a processor at each traffic signal controller cabinet. The priority control system shall match the existing system at other traffic signals.

The priority control system shall be fully compatible with and supported by the existing City's traffic signal priority Central Management Software (CMS).

I. SYSTEM DESCRIPTION

A priority control system shall operate in a manner that allows infrared as well as other signal control technologies to interoperate and activate one another in a consistent manner. The priority control system shall consist of a matched system of vehicle equipment and intersection equipment capable of employing both data-encoded radio communications to identify the presence of designated priority vehicles, as well as data-encoded infrared signaling communications. In preemption mode, the data-encoded communication shall request the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available. A record of system usage by agency identification number, vehicle classification and vehicle identification number shall be created. The system software shall support call history analysis and reporting across any subset of intersections and/or vehicles independent of activation

method. System software shall also support both onsite and remote programming and monitoring of the priority control system.

Intersection detection equipment will consist of an infrared detector at or near the intersection that is connected to a phase selector located in the intersection controller cabinet. The infrared detector, mounted on signal pole mast arms or vehicle signal head, receives the data-encoded infrared signal from the infrared equipped vehicle and transmits information through detector cable designed to convert infrared light energy at the proper wavelength into analog voltage signals that can be evaluated and decoded by the phase selector.

The phase selector shall be capable of receiving data encoded signals from infrared and other signals and combine the detection signals into a single set of tracked vehicles requesting priority activation. The phase selector will process the vehicle information to ensure that the vehicle is (1) in a predefined approach corridor, (2) heading toward the intersection, (3) requesting priority, and (4) within user-settable range. The phase selector shall treat the combined, single set of tracked calls with first come first served priority methodology within a given priority level. Arbitration between infrared signal intensity and other signal distance/ETA shall be first come first served methodology based on time of detection as each equipped vehicle reaches its programmed threshold.

When these conditions are met, the phase selector shall generate a priority control request to the traffic controller for the approaching priority vehicle. The system shall offer compatibility with most signal controllers, e.g. NEMA (National Electrical Manufacturers Association) 170/2070 controllers. The system can be interfaced with most globally available controllers using the controller's preemption inputs. RS-232, USB and Ethernet interfaces shall be provided to allow management by on-site interface software and central software. The required priority control system shall be vehicle ID compatible with neighboring jurisdictions using optical emergency vehicle preemption. This will allow neighboring jurisdictions with mutual aid agreements with the City of Stockton to use the preemption system in Stockton and vice versa.

The system shall allow for relative priority for each emitter classes. The system shall allow for evacuation mode.

II. MATCHED SYSTEM COMPONENTS

The required priority control, data-encoded, infrared communications system shall be comprised of five basic matched components: data-encoded emitter, infrared detector, detector cable, Auxiliary Interface Panel (AIP), and phase selector. This system shall be installed, with all five basic components, at each signalized location. In addition, a card rack (Model # 760) and an electromechanical interface card shall be available if required. To ensure system integrity, operation and compatibility, all components shall be from the same manufacturer. The system shall offer compatibility with most signal controllers, e.g., electromechanical, NEMA (National Electrical Manufacturers Association), 170. Interfacing to an electromechanical controller may require the use of an interface card. The priority system shall be fully compatible with and supported by the existing City's traffic signal priority Central Management Software (CMS).

- A. Infrared Detector (GTT model # 721). The detector shall change the infrared signal to an electrical signal. It shall be located at or near the intersection. It shall send the electrical signal, via the detector cable, to the phase selector.
- B. Detector Cable (GTT model # 138). The detector cable shall carry the electrical signal from the detector to the phase selector. The cable shall be made by the same manufacturer as the rest of the priority control system.
- C. Auxiliary Interface Panel (AIP), **required only if indicated on the plans**. An AIP shall be installed in the traffic signal cabinet where a new cabinet is not installed. The auxiliary panel shall provide additional preemption outputs if needed. It shall also provide a connection point for the phase selector to monitor the status of the intersection's green lights (green sense). Additional RS-232 communication ports may also be accessed via this panel. If additional outputs are not required, an auxiliary harness shall be used to monitor the status of the intersection's green lights.
- D. Phase Selector (GTT model # 764). The phase selector shall recognize inputs from both infrared and other signal activation methods at the intersection and supply coordinated inputs to the controller. The phase selector shall process the data in order to validate that all parameters required for granting a priority request are met. It shall be located within the controller cabinet at the intersection. It shall request the controller to provide priority to a valid priority vehicle by connecting its outputs to the traffic controller's preemption inputs.
- E. A 6-foot Cat5e (Red Color) cable and a SFP-1 Copper 10/100/1000 Mbps RJ45 Small Form-Factor Pluggable module shall be furnished to enable the phase selector to communicate through the Ethernet switch with Opticom central software.

RELIABILITY

- A. All equipment supplied as part of the infrared priority control system intended for use in the controller cabinet shall meet the following electrical and environmental specifications spelled out in the NEMA Standards Publication TS2 1992, Part 2:
 - 1. Line voltage variations per NEMA TS2 1992, Paragraph 2.1.2.
 - 2. Power source frequency per NEMA TS2 1992, Paragraph 2.1.3.
 - 3. Power source noise transients per NEMA TS2 1992, Paragraph 2.1.6.1.
 - 4. Temperature range per NEMA TS2 1992, Paragraph 2.1.5.1.
 - 5. Humidity per NEMA TS2 1992, Paragraph 2.1.5.2.
 - 6. Shock test per NEMA TS2 1992, Paragraph 3.13.9.
 - 7. Vibration per NEMA TS2 1992, Paragraph 3.13.8.
- B. Each piece of equipment supplied as part of the priority control system intended for use in or on priority vehicles shall operate properly across the entire spectrum of combinations of environmental conditions (temperature range, relative humidity, vehicle battery voltage) per the individual component specifications.

RESPONSIBILITIES

- A. The manufacturer of the required infrared priority control system and/or the manufacturer's representative shall provide responsive service before, during and after installation of the priority control system. The manufacturer and/or the manufacturer's representative, as consultants to the installer, shall provide certified, trained technicians having traffic systems industry experience and operational knowledge of priority control systems.
- B. The lowest fully responsive bidder shall be required to supply working production components specified in this Specification within 14 calendar days from the bid opening date. Failure to do so shall render the bid non-responsive.
- C. Paragraph B. shall not be required if, prior to the bid opening, the bidder demonstrated to the city that the equipment bid meets these specifications.

SUBSTANTIATED WARRANTY

- A. The manufacturer of the required infrared priority control system shall warrant that, provided the priority control system has been properly installed, operated and maintained, component parts of a matched component system (see Section II) that prove to be defective in workmanship and/or material during the first five (5) years from the date of shipment from the manufacturer shall be covered in a documented system-protection plan, plus provide an added five-year maintenance coverage for repair or replacement at a fixed deductible charge for a total of ten (10) years of product coverage.
The manufacturer must substantiate its financial ability to respond to warranty claims. The guarantee shall be determined in reference to the manufacturer's business assets and financial experience over the preceding five-year period.
- B. In addition, upon request, the manufacturer shall provide documentation proving ability to financially support the ten (10) year provisions of the warranty/maintenance period. Documentation shall include appropriate financial reports for the previous five business years.
- C. The protection plan shall warrant that component parts of a matched component system that are not subject to coverage limitations and prove to be defective in workmanship and/or material during the first five (5) years from the date of shipment from manufacturer shall be repaired at no charge, and that extended coverage with a fixed repair deductible shall be available for an additional five (5) years.
- D. In total, the warranty/maintenance coverage must assure that system components shall be available to allow system operation during the ten (10) year warranty/maintenance coverage.
- E. A copy of the manufacturer's written warranty outlining the conditions stated above shall be supplied with the bid. Coverage and coverage limitations are to be administered as detailed in the manufacturer's Warranty/Maintenance document.

CERTIFICATE OF INSURANCE

The manufacturer of the required infrared priority control system shall provide a certificate of product liability insurance protection for \$5,000,000 assuring the priority control user that the manufacturer is insured against civil damages if proven to be at fault for an accident due to equipment failure within the system of matched priority control components. This certificate, however, need not, and is not meant to, provide liability

insurance protection to the priority control system dealer, installer or user.

USER SUPPORT SERVICES

The manufacturer of the required infrared priority control system shall offer support programs to assist the purchase and implementation of a priority control system program, including:

- A. A preferred lease program to finance purchase of a system.
- B. Public relations assistance to promote the system within the user community.
- C. Intersection survey service to document appropriate equipment interfaces.
- D. Customized proposals to assist the procurement process.
- E. Driver Training Program

CERTIFICATION

The manufacturer of the required infrared priority control system shall certify that all component products are designed, manufactured and tested as a system of matched components and shall meet or exceed the requirements of this specification.

SYSTEM OPERATION

The Contractor shall demonstrate that all of the components of each system are compatible and will perform satisfactorily as a system.

Operating sequence shall be initiated when the detector receives optical energy of the required identification code and sequential flash rate from an emitter.

Detector shall transform the optical energy signals into electrical signals and transmit the electrical signals to the phase selector module for processing.

The phase selector module shall place a logical true call (high priority) or a pulsing logical true call (6.25 Hz square wave for second priority) into the signal controller to advance to and hold the green display, which grants right-of-way to the authorized vehicle(s) displaying the optical energy pulses.

When a preemption call is registered while the controller is serving a vehicular phase or phase combination other than the preemption phase(s) called for, a clearance interval for the phase(s) in conflict shall be displayed immediately after the minimum green period. If a preemption call is registered while the controller is servicing the preemption phase or phase combination called for, the controller shall remain in that phase or phase combination at least four (4) seconds after the call drops out. If a preemption call is registered while the controller is servicing a pedestrian call, the controller shall immediately terminate the WALK indication and time a separately programmable flashing DONT WALK indication before serving the preemption phase(s) called for.

Phase selector module shall obtain and hold the desired green display(s) for a minimum of four (4) seconds, even if the optical energy signals cease before entering the preempt green display(s).

Phase selector module shall allow the signal controller to resume normal operation 6 to 10 seconds after optical energy signals are lost, if the optical energy signals are lost after

entering the pre-empt green display(s).

Preemption equipment shall be installed in such a manner that the internal wiring of the controller, as normally furnished by the manufacturer, is not altered.

Phase selector module shall provide for assigning right-of-way to one of two (1 of 2) priority levels on either of two (2) channels. Priority is given on a first-detected, first- served basis, except that a high priority optical transmission shall have precedence over a low priority optical transmission when both are detected concurrently.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals for doing the work described in this section (77-1.30) shall be included in the lump sum price paid for "Traffic Signals and Electrical" and no additional compensation shall be allowed therefor.

77-2 BLANK

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77-4 TRAFFIC SIGNAL TURN ON AND STREET LIGHT REMOVAL

77-4.01 Traffic Signal Turn On and Change Over

The Contractor shall be responsible to coordinate the turn on or change-over of any traffic signal operation. He shall notify the Resident Engineer and the City Traffic Engineer of the impending turn on or activation of any traffic signal included in this contract at least seven (7) working days in advance of the turn on or change-over. Traffic signal turn on or change over shall occur only on Tuesday and Wednesday, except on holidays. Upon turn on or change-over of any traffic signal, the Contractor shall demonstrate satisfactory compliance with all requirements necessary for the operation of the traffic signal, including, but not limited to, Fiber Optic cabling and communication equipment, PTZ camera and communication equipment, appropriate detection, Vehicle Pre-emption system, controller response, pedestrian countdown and accessible pedestrian system sound features operating, and the traffic signal response to the various calls.

In no case shall the traffic signal be left in operation if any of the design features of the operation are found to be inoperable. All signal and pedestrian heads shall be covered by signal head jackets again and stop signs shall be re-installed.

The intersection shall be protected with portable "Stop" signs and certified Flaggers during any traffic signal turn on or change over. Flaggers and stop signs shall remain on site until all attendees to the turn on or change-over are satisfied that the traffic signal is functioning appropriately.

Mounted "Stop" signs on barricades shall be maintained *on site for immediate* application to any intersection with traffic signal under construction. The Contractor shall respond to *any interruption of normal functioning of a traffic signal within two (2) hours.*

The Contractor shall be responsible for the coordination of all of the necessary sub-contractors for a successful turn on or change-over of a traffic signal, and to determine that all of the appropriate remedies are in place to return a traffic signal to its prior operation mode should a failure of any of the components necessary for successful operation occur.

77-4.02 Street Light Removal

The street lighting system shall fully conform to the National Electrical Code and City of Stockton Standard Specifications and details.

The Contractor shall take care in removing the existing street light and transport to the City corporation yard. When the existing street light is damaged and new material is necessary, such material shall be a replacement of the original and shall be paid for at the Contractor's expense.

Existing foundations shall be removed and disposed of off-site.

DIVISION IX TRAFFIC CONTROL DEVICES

SECTION 84 – MARKINGS

84-1.01 Traffic Stripes, Pavement Markings, and Pavement Markers

Traffic stripes and pavement legends, including crosswalks, shall be placed as shown on the plans, must comply with the California MUTCD, as modified herein, and as directed by the Engineer. All pavement **traffic stripes**, legends, arrows and crosswalks shall be installed with hot applied thermoplastic pavement material. The width and patterns of striping lines shall conform to the striping details shown in Figures 3A-101 (CA) through 3A-113 (CA) in the California MUTCD.

The thermoplastic material shall be free of lead and chromium and conform to State Specification PTH-02ALKYD (for markings) and PTH-02SPRAY (for stripes). Thermoplastic material shall be applied to the pavement at a minimum thickness of 0.060 inches for long lines (4 inches stripes and 8 inches stripes in width) and 0.100 inches for all legends and arrows. The crosswalk lines and limit lines shall be installed at a minimum thickness of 0.125 inches.

A double extruded thermoplastic traffic stripe consisting of two 4-inch wide yellow stripes is measured as 2 traffic stripes.

A double sprayable thermoplastic traffic stripe consisting of two 4-inch wide yellow stripes is measured as 1 traffic stripe.

If the contractor chooses to install stripes by using a cart (extruded) rather than a striping vehicle, all striping shall be applied to the pavement at a minimum thickness of 0.090 inches. Glass beads shall conform to State Specification in Sections 84-2.02D, 84-2.02E,

and 84-2-03C(2)e. Thermoplastic pavement markings and stripes shall be free of runs, bubbles, craters, drag marks, stretch marks, and debris.

Use appropriate installation procedures according to manufacturer. If pavement markings are applied to existing surface over existing painted legends (arrows and crosswalks), existing pavement legends (arrows and sidewalks) shall be removed before thermoplastic material is applied. For either material, pavement shall be preheated to remove all residual moisture prior to installation.

At intersections where existing pavement is removed and replaced, Contractor shall install new crosswalk control points for the City to review and approve.

Configuration of traffic stripes, pavement markings, and crosswalks shall conform to the detail and methods as set forth in the latest issue of the California MUTCD and Caltrans Specifications, unless specifically modified on the plans.

All existing traffic stripes and pavement markings shall be removed where shown on the plans, where the existing striping conflicts with proposed striping, and as designated by the Engineer.

Existing pavement markers, including underlying adhesive, when no longer required for traffic lane delineation, as directed by the Engineer, shall be removed and disposed of.

Removal of traffic stripes and pavement markings, or the removal of objectionable material, shall be performed using methods approved in advance by the Engineer. All resulting residue and dust shall be removed immediately from the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation. **The removal of yellow paint and thermoplastic material shall include testing for lead prior to disposal of the material. Disposal of materials containing lead shall conform to state approved practices.** The removal of yellow paint and thermoplastic material shall also conform to the provisions in Section 14-1.01 "Construction Site Waste Materials Management" of these special provisions.

The Contractor shall place control points for the Engineer to review and approve. No additional "cat tracks" shall be placed until control points are approved by the Engineer. The Contractor shall obtain approval from the Engineer on all striping cat tracks prior to final application and striping and markers.

The Contractor shall place and remove any temporary striping required for routing traffic through the project area.

All thermoplastic shall be provided by the Contractor. Manufacturer and specifications shall be submitted for approval and shall conform to the specifications contained herein. All thermoplastic supplied shall conform to the local air pollution regulations. Traffic line markings shall be reflectorized conforming to the Caltrans Specifications, Section 84-2, "Traffic Stripes and Pavement Markings".

Existing surface which is to receive the thermoplastic material shall be mechanically wire

brushed to remove all dirt and contaminants. Thermoplastic material shall be applied only to the dry pavement surfaces and only when the pavement surface temperature is above fifty (50°F) degrees Fahrenheit. Thermoplastic shall be applied only on a thoroughly dry surface and during periods of favorable weather.

The Contractor shall make all necessary conform striping as required. The completed stripes and markings shall be sharp and clear with clean, well-defined edges.

Any damage by the elements to the newly stripe or marking due to the failure of any Contractor to protect his work shall be repaired by him at no additional cost. Any overspray or tracking of fresh thermoplastic material onto unpainted surfacing shall be removed by any methods to the satisfaction of the Engineer.

On one-way streets and median-divided streets, the side of the retroreflective raised pavement markers that is visible to traffic proceeding in the wrong direction shall be red. The other retroreflective side shall be white or yellow as per the detail. This section is applicable to Details 9, 10, 12, 13, 25, 25A, 26 and 27 in the California MUTCD.

Blue Raised Pavement Markers shall be installed after any surface treatment (overlay, micro-surfacing, chip-seal, cape-seal, etc.) solely for aiding in locating fire hydrants. Typical marker locations are shown on Figure 3B-102 (CA) of the California MUTCD.

(1) *Two-Way Streets*—Markers should be placed 6 inches from the edge of painted centerline on the side nearest the fire hydrant. If the street has no centerline, the marker should be placed 6 inches from the approximate center of the roadway on the side nearest the hydrant.

(2) *Streets with Left Turn Lane at Intersection*—Markers should be placed 6 inches from the edge of painted white channelizing line on the side nearest the hydrant.

(3) *Streets with Continuous Two-Way Turn Lane*—Markers should be placed 6 inches from the edge of the painted yellow barrier line on the side nearest the fire hydrant.

(4) *One-way streets and median-divided streets*—Markers should be placed 6 inches from the edge of lane line on the side nearest the fire hydrant (at least 12' from curb or edge of traveled way).

The noise level created by the combined grinding activities must not exceed 86 dBA when measured at a distance of 50 feet at right angles to the direction of travel.

DIVISION XI MATERIALS

SECTION 90 – CONCRETE

Attention is directed to the Section 90, “Concrete” of the Standard Specifications and these Special Provisions.

90-1.01 Minor Concrete

Section 90-2, "Minor Concrete", of the Caltrans Specifications is amended by adding the following:

Mineral admixture will be required in the manufacture of concrete containing aggregate that is determined to be "deleterious" or "potentially deleterious" when tested in accordance with ASTM Designation: C 289. The use of mineral admixture in such concrete shall conform to the requirements in Section 90-1.02 of the Caltrans Specifications, "Materials", except the use of Class C mineral admixture will not be permitted.