

SPECIFICATIONS CONSTRUCTION DOCUMENTS

Headquarters Replacement
Phase 1
Tyler State Park
Texas Parks and Wildlife Department

July 03, 2020





Architecture Planning Interior Design Preservation

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SECTION 00 0101

PROJECT CERTIFICATIONS

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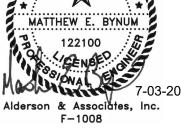
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23 81 25

23 81 27

7700 Torino, Suite 101 San Antonio, TX 78229 210.614.1110

Split System Air Conditioning Condensing Units

Mini-Split System Air-Conditioners

-1008

TPWD TYLER STATE PARK HEADQUARTERS REPLACEMENT PHASE 1

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SECTION 031000

CONCRETE FORMING AND ACCESSORIES

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. Form-facing material for cast-in-place concrete.
- 2. Form liners.
- 3. Insulating concrete forms.
- 4. Shoring, bracing, and anchoring.

B. Related Requirements:

- 1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.
- 2. Section 321316 "Decorative Concrete Paving" for formwork related to decorative concrete pavement and walks.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous construction waste.
 - 2. Recycling nonhazardous construction waste.
 - 3. Disposing of nonhazardous construction waste.

1.02 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible. Divert a minimum of 75% by weight of construction and demolition debris from disposal in landfills and incinerators.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Land clearing debris, including brush, branches, logs, and stumps.
 - 6. Concrete.
 - 7. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 8. Glass.
 - 9. Gypsum drywall and plaster.
 - 10. Plastic buckets.
 - 11. Paint.

E. Contractor shall:

- 1. Develop, coordinate, and follow a Waste Management Plan designed to implement these requirements.
- 2. Provide and pay all costs for labeled containers for receipt of recyclable materials and for disposal of recyclable material.
- 3. Monthly log construction and demolition materials diverted from landfill and either reused on-site or sent to an approved recycling facility. An approved recycling facility is a facility that can legally accept construction and demolition waste for the purpose of processing the materials into an altered form for the manufacture or a new product.
- F. The following sources may be useful in developing the Waste Management Plan:
 - 1. State Recycling Department, at Texas Facilities Commission.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.03 RELATED REQUIREMENTS

- A. Refer to Owner's General Conditions and Special Conditions for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Refer to Owner's General Conditions and Special Conditions for additional requirements related to trash/waste collection and removal facilities and services.
- C. Refer to Owner's General Conditions and Special Conditions for Waste prevention requirements related to delivery, storage, and handling.
- D. Refer to Owner's General Conditions and Special Conditions for additional requirements to demolition, cutting and patching, installation, protection, and cleaning.

1.04 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- E. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- F. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- H. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- I. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- J. Return: To give back reusable items or unused products to vendors for credit.
- K. Reuse: To reuse a construction waste material in some manner on the project site.
- Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- M. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- N. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- O. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- P. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- Q. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions for submittal procedures.
- B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- C. Waste Management Plan: Include the following information:

- 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
- 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
- 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
- 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
- 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
- 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards (cubic meters).
 - c. Include weight tickets as evidence of quantity.
 - 7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 EXECUTION

2.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect and Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - Comply with Division 1 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Waste Management Coordinator: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
- D. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- E. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- F. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- G. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- H. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- J. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- K. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- L. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

2.02 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Use recycling receivers and processors for the following:
 - Landclearing: Landclearing debris includes stumps, trees, and brush, primarily processed into a mulch or compost base.
 - 2. Dimensional Wood: Keep wood clean and site separated.
 - 3. Concrete

- 4. Metals
- 5. Gypsum
- 6. Used Building Materials
- 7. Paper
- 8. Old Corrugate Cardboard
- Plastic
- C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - Provide appropriately marked containers or bins for controlling recyclable waste until they
 are removed from Project site. Include list of acceptable and unacceptable materials at
 each container and bin.
 - Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

2.03 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Forms for cylindrical columns.
 - 4. Pan-type forms.
 - 5. Void forms.
 - 6. Form liners.
 - 7. Insulating concrete forms.
 - 8. Form ties.
 - 9. Waterstops.
 - 10. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
 - 3. Indicate location of waterstops.
 - 4. Indicate form liner layout and form line termination details.
 - 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
 - 6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:

- For waterstops.
- 2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

- B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).

- APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
- 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
- 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces without spiral or vertical seams not exceeding specified formwork surface class.
 - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Henry Company.
 - b. Sika Corporation.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kryton International Inc.
 - b. Sika Corporation.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

- 3.1 INSTALLATION OF FORMWORK
 - A. Comply with ACI 301.
 - B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
 - C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D. 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
 - D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
 - E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
 - F. Do not use rust-stained, steel, form-facing material.
 - G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

- 1. Provide and secure units to support screed strips
- 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beamgirder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls at 30'-0" o.c. or as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches on center.
 - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Alian center bulbs.
 - 6. Clean waterstops immediately prior to placement of concrete.
 - 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 and manufacturer's instructions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Install forms in running bond pattern.
 - 1. Align joints.
 - 2. Align furring strips.

- D. Construct forms tight to prevent loss of concrete mortar.
- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

- 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

SECTION 03 2000

CONCRETE REINFORCING

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. Steel reinforcement bars.
- 2. Welded-wire reinforcement.

B. Related Requirements:

- 1. Section 033816 "Unbonded Post-Tensioned Concrete" for reinforcing related to post-tensioned concrete.
- 2. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
- 3. Section 034500 "Precast Architectural Concrete" for reinforcing used in precast architectural concrete.
- 4. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks
- 5. Section 321316 "Decorative Concrete Paving" for reinforcing related to decorative concrete pavement and walks.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Epoxy repair coating.

- 3. Zinc repair material.
- 4. Bar supports.
- 5. Mechanical splice couplers.
- 6. Structural thermal break insulated connection system.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - 3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- D. Delegated-Design Submittal: For structural thermal break insulated connection system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
 - A. Qualification Statements: For testing and inspection agency.
 - B. Welding certificates.
 - Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
 - C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 - 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 - D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
 - E. Field quality-control reports.
 - F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.
 - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

- a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
- c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
- d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- D. Mechanical Splice Couplers: ACI 318 Type 1 or Type 2as indicated on the Contract Drawings, same material of reinforcing bar being spliced; tension-compression type.
- E. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.
 - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.
- H. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:

- 1. Steel-reinforcement placement.
- 2. Steel-reinforcement mechanical splice couplers.
- 3. Steel-reinforcement welding.
- D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 03 2000

SECTION 03 3000

CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

- 1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
- 2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
- 3. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
- 4. Section 033543 "Polished Concrete Finishing" for concrete floors scheduled to receive a polished concrete finish.
- 5. Section 035300 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
- 6. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
- 7. Section 321313 "Concrete Paving" for concrete pavement and walks.
- 8. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

- 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.

2. Review the following:

- Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- I. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement.
 - 4. Blended hydraulic cement.
 - 5. Silica fume.
 - 6. Performance-based hydraulic cement
 - 7. Aggregates.
 - 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 - 9. Color pigments.
 - 10. Fiber reinforcement.
 - 11. Vapor retarders.
 - 12. Floor and slab treatments.
 - 13. Liquid floor treatments.
 - 14. Curing materials.

- a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 15. Joint fillers.
- 16. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
 - Mixture identification.
 - 2. Minimum 28-day compressive strength.
 - 3. Durability exposure class.
 - 4. Maximum w/cm.
 - 5. Calculated equilibrium unit weight, for lightweight concrete.
 - 6. Slump limit.
 - 7. Air content.
 - 8. Nominal maximum aggregate size.
 - 9. Steel-fiber reinforcement content.
 - 10. Synthetic micro-fiber content.
 - 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 - 12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 - 13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 - 14. Intended placement method.
 - 15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

- 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Samples: For manufacturer's standard colors for color pigment.
- E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.
 - 3. Exposure Class designation.
 - 4. Formed Surface Finish designation and final finish.
 - 5. Final finish for floors.
 - 6. Curing process.
 - 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.

- 2. Ready-mixed concrete manufacturer.
- 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Vapor retarders.
 - 9. Semirigid joint filler.
 - 10. Joint-filler strips.
 - 11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement.
 - 4. Blended hydraulic cement.
 - Silica fume.
 - 6. Performance-based hydraulic cement.
 - 7. Aggregates.
 - 8. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 - 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 - 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
 - 1. Post-Installed Concrete Anchors Installers; ACI-certified Adhesive Anchor Installer.

- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.
- 1.9 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.

- 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
- 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 - Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.

- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
- c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
- 2. Maximum Coarse-Aggregate Size: 1 inch, 3/4 inch nominal.
- 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Raven Industries. Inc.
 - b. Stego Industries, LLC.

2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Sika Corporation.
 - d. W.R. Meadows, Inc.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- D. Water: Potable or complying with ASTM C1602/C1602M.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.
- F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.
- G. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.
- H. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.

- I. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W.R. Meadows, Inc.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - 5. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, slab on grade, and slab on metal deck.
 - 1. Minimum Compressive Strength: per Contract Drawings
 - 2. Maximum w/cm: 0.45.
 - 3. Slump Limit: per Contract Drawings.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls at 30'-0" on center maximum. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

- 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
- 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

- 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
- 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Do not place concrete floors and slabs in a checkerboard sequence.
 - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Maintain reinforcement in position on chairs during concrete placement.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 5. Level concrete, cut high areas, and fill low areas.
 - 6. Slope surfaces uniformly to drains where required.
 - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 - 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
 - 2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.

- d. Surface Tolerance: ACI 117 Class B.
- e. Locations: Apply to concrete surfaces to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3. ACI 301 Surface Finish SF-3.0:

- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
- b. Remove projections larger than 1/8 inch.
- c. Patch tie holes.
- d. Surface Tolerance: ACI 117 Class A.
- e. Locations: Apply to concrete surfaces exposed to public view,.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the inplace concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

2. Grout-Cleaned Rubbed Finish:

- a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
- b. Do not clean concrete surfaces as Work progresses.
- c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
- d. Wet concrete surfaces.
- e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
- f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

3. Cork-Floated Finish:

- a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
- b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
- c. Wet concrete surfaces.
- d. Compress grout into voids by grinding surface.
- e. In a swirling motion, finish surface with a cork float.
- f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

- 4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish.
 - Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match field sample panels.
- C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
 - 1. Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi.
 - 2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
 - 3. Surface Continuity:
 - Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match field sample panels.
 - 4. Abrasive Blasting:
 - a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
 - b. Determine type of nozzle pressure and blasting techniques required to match field sample.
 - c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Brush Texture: Remove cement matrix to dull surface sheen and expose face of fine aggregate, with no significant reveal.
 - 2) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of 1/16 inch.
 - 3) Medium Texture: Generally, expose coarse aggregate with slight reveal and with a maximum reveal of 1/4 inch.
 - 4) Heavy Texture: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter, with reveal range of 1/4 to 1/2 inch.
 - d. Maintain required patterns or variances in reveal projection to match field sample panels.
- D. High-Pressure Water-Jet Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
 - 1. Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi.
 - 2. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
 - 3. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 - 4. Maintain required patterns or variances in reveal projection to match field sample panels.

- E. Bushhammer Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
 - 1. Perform bushhammer finish to concrete that has achieved a minimum compressive strength of 4500 psi.
 - 2. Surface Continuity:
 - a. Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.

Surface Cut:

- a. Maintain required depth of cut and general aggregate exposure.
- Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
- 4. Remove impressions of formwork and form facings with exception of tie holes.
- 5. Maintain required patterns or variances of cut as shown on Drawings or to match field sample panels.
- 6. Maintain control of concrete chips, dust, and debris in each Work area, limiting migration of airborne materials and dust by use of tarpaulins, wind-breaks, or similar devices.

F. Related Unformed Surfaces:

- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
- 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

- While still plastic, texture concrete surface that has been screeded and bull-floated or darbied
- 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
- Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

- 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
- 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
- 3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

- 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
- 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
- 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
- 4. Do not add water to concrete surface.
- 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
- 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
- 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Slabs on Ground:

1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and 1/16 inch in 2ft.

b. Suspended Slabs:

- 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
- 2) Specified overall values of flatness, F_F 35; and of levelness, F_L 20; with minimum local values of flatness, F_F 24; and of levelness, F_L 15.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
 - 1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.

- c. After broadcasting and tamping, apply float finish.
- d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
 - 1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 - 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 - 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 - 4. After final floating, apply a trowel finish.
 - 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

- 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
- 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
- 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
 - 1. Cast-in inserts and accessories, as shown on Drawings.

2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 - Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 - 3. If forms remain during curing period, moist cure after loosening forms.
 - 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

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- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
- 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
- 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 2) Rewet absorptive cover, and cover immediately with polyethylene moistureretaining cover with edges lapped 6 inches and sealed in place.
- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than seven days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.
 - 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.

- d. Fill and compact with patching mortar before bonding agent has dried.
- e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
- 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
- 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

- 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- 3. After concrete has cured at least 14 days, correct high areas by grinding.
- 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
- 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
- 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.

- b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
- c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
- d. Place, compact, and finish to blend with adjacent finished concrete.
- e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.

- 10) Design compressive strength at 28 days.
- 11) Concrete mixture designation, proportions, and materials.
- 12) Field test results.
- 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
- 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

- 1. Headed bolts and studs.
- 2. Verification of use of required design mixture.
- 3. Concrete placement, including conveying and depositing.
- 4. Curing procedures and maintenance of curing temperature.
- Verification of concrete strength before removal of shores and forms from beams and slabs
- 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 - 3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C1064/C1064M:

- a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
- 6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- 7. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of four standard cylinder specimens for each composite sample.
- 8. Compressive-Strength Tests: ASTM C39/C39M.
 - Test one specimen of laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
- 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- 12. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
- 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

- 1. Protect from petroleum stains.
- 2. Diaper hydraulic equipment used over concrete surfaces.
- 3. Prohibit vehicles from interior concrete slabs.
- 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
- 5. Prohibit placement of steel items on concrete surfaces.
- 6. Prohibit use of acids or acidic detergents over concrete surfaces.
- 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
- 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 3000

SECTION 03 3560 CONCRETE FLOOR FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Products and procedures for placement, finishing, and polishing cast-in-place concrete floors.

1.02 RELATED SECTIONS

- A. Section 03 3000 Cast-in-Place Concrete.
- B. Section 03 3000 Cast-In-Place Concrete: Flatness and levelness tolerances.
- C. Section 07 9005 Joint Sealers.

1.03 PERFORMANCE

A. Minor variations in appearance of colored concrete/mortar, which are similar to natural variations in color and appearance of unpigmented concrete/mortar, are acceptable, provided the variations are within the range and the same character as the approved mock-up.

1.04 REFERENCE STANDARDS

- A. ACI 301 Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- B. ACI 302.1R Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007) .
- C. ASTM E 1155 Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).
- D. NFSI 101-A National Floor Safety Institute Standards.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Mix Designs: Evaluate concrete mix designs and material sources and product data for manufactured products to be incorporated into the specific mix design for concrete floors. Submit evaluation highlighting any deviations from Contract Documents which would tend to reduce the quality of the finish.
- C. Samples for Initial Selection:
 - 1. Aggregates: Labeled, sealed bags with one pound of each aggregate in concrete mix.
 - 2. Integral Color Pigment: Full range of available standard manufacturer's samples of actual products showing colors.
- D. Samples for Verification: Submit 12" square samples of polished finish in each color, texture, and pattern specified; include not less than 3 in each sample set showing limits of variations expected for each color, texture, and pattern specified.
- E. Product Data: Provide complete technical data on each product specified, including information on compatibility of different products and limitations.
- F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- G. Maintenance Data: Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use. Include precaution against cleaning products and methods which may be detrimental to polished finishes and performance.

1.06 QUALITY ASSURANCE

- A. Concrete Producer Qualifications: Firm experienced in manufacturing ready-mixed concrete products and that complies with following requirements for production facilities and equipment:
 - 1. ASTM C 94.
 - 2. NRMCA's Certification of Ready Mixed Concrete Production Facilities.

B. Polisher Qualifications:

- 1. Experience: Company with not less than 5 years experience in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-services performance; and with sufficient production capability, facilities, and personnel to produce required Work.
- 2. Supervision: Maintain competent supervisor who is at Project during times specified Work is in progress, and who is experienced in installing systems similar to type and scope required for Project.
- 3. Trade Association: Member in good standing of IPCI.
- C. Walkway Auditor: Person certified by NFSI, trained to test polished surfaces for static coefficient of friction according to NFSI 101-A.
- D. Static Coefficient of Friction: Products and polishing operations shall achieve following as determined by quality control testing according to NFSI-A:
 - 1. Level Floor Surfaces: Minimum 0.6.
 - 2. Sloping Floor Surfaces: Minimum 0.8.
 - 3. All surfaces must meet TAS 302.1.

1.07 PRE-INSTALLATION MEETING

- A. Prior to placing concrete for areas scheduled for polished concrete floor finish, conduct meeting at Project to comply with requirements of applicable Division 01 Sections
- B. Required Attendees;
 - 1. Owner.
 - Architect.
 - 3. Contractor, including supervisor.
 - 4. Polisher, including supervisor.
 - 5. Concrete producer.
 - 6. Concrete finisher, including supervisor
 - 7. Walkway auditor.
- C. Minimum Agenda: Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
 - 1. Tour mock-up and representative areas of required work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of installation and other preparatory Work performed by other installers.
 - 2. Review Contract Document requirements.
 - 3. Review approved submittals.
 - 4. Review installation procedures, including, but not limited to:
 - a. Concrete placement, finishing, and preparation for polished finish.
 - b. Concrete curing.
 - c. Application of polishing products.
 - d. Grinding and polishing operations.
 - e. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.

1.08 MOCK-UP

- A. Before performing work of this Section, provide as many field samples as required to verify selections made under submittals and to demonstrate aesthetic effects of polished finish. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing.
- B. Provide an 8'X10' test area of polished floor as specified in section 03 3000. Coordinate location with architect so that the Mock up is out of public view.
- C. Use same personnel, including supervisors, which will perform work.
- D. Install products and materials according to specified requirements.
- E. Mock-up will be used to evaluate:

- 1. Concrete substrate preparation,
- 2. Compliance with approved submittals,
- 3. Uniformity of exposed aggregate, and
- 4. Uniformity of sheen.
- F. Show maximum variation that will exist in work.
- G. When approved the mock-up will demonstrate the minimum standard of quality for proceeding with this work.
- H. Approved mock-up shall remain for comparison as part of the finished work. Protect approved field mock-ups from elements with weather-resistant covering.

1.09 PROJECT CONDITIONS

- A. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.
 - 1. Prohibit the following over concrete surfaces to be polished:
 - a. Vehicle parking.
 - b. Pipe cutting operations.
 - c. Ferrous metals storage.
 - 2. Protect concrete surfaces to be polished from following:
 - a. Petroleum, oil, hydraulic fluid, or other liquid dripping from equipment.
 - b. Acids and acidic detergents.
 - c. Painting activities.

1.10 FIELD CONDITIONS

- A. Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting polishing operations.
- B. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.
- C. Do not apply materials in wet weather.
- D. Do not finish floors until interior heating system is operational.
- E. Where feasible, prepare surface and apply concrete floor sealer after other interior finish work is completed and before baseboards are installed.
- F. Maintain ambient temperature of 60 degrees F. minimum.
 - 1. Concrete Floor Sealer: Do not apply when air or surface temperature is below 60 degrees F.
- G. Provide ventilation sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.
- H. Protect concrete slabs from damage and staining both before and after application of concrete finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Contract Documents are based on products by American Concrete Technologies, Inc. (2242 Forest Park Blvd., Fort Worth, Texas 76110, 817-927-1980, fax 817-926-5024, www.diamond polish.com) to establish a standard of quality. Other available products having equivalent characteristics may be considered, provided deviations are minor and do not change concept expressed in Contract Documents as judged by Architect.

2.02 CONCRETE MATERIALS

A. Cementitious Materials: As specified in appropriate Division 03 Section.

2.03 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from juts or kenaf, weighing approximately 9 oz. per sq. yd.

2.04 APPLIED PRODUCTS

A. Liquid Densifier:

- 1. Description: Odorless, non-hazardous, potassium silicate that penetrates concrete to react with free lime and calcium hydroxide to produce permanent chemical reaction that hardens, densifies and tightens concrete surface.
- 2. Basis of Design: Amerete, Inc.; Everhard.

B. Patching Compound:

- 1. Description: Compound composed of 40 percent portland cement, 45 limestone, and 15 percent vinyl acetate copolymer, when mixed with dust salvaged from grinding process forms a paste that hardens when surface imperfections are filled.
- 2. Basis of Design: Amerete, Inc.; Durafil.

C. Grout Material:

- Description: Clear modified silicate sealant, containing no pore clogging latex, when mixed with dust salvaged from grinding process forms a paste that reacts with calcium hydroxide in concrete that hardens when surface imperfections are filled.
- 2. Basis of Design: Amerete, Inc. Filzit Surfacing System.

D. Polish Guard:

- Description: Non-film forming, stain resistant, food resistant, chemical stain resistant, impregnating sealant designed to be used on concrete surfaces previously densified.
- 2. Basis of Design: Amerete, Inc.; Resistall.

E. Protective Cover:

- 1. Description: Non-woven, puncture and tear resistant, polypropylene fibers laminated with a multi-ply, textured membrane, not less than 18 mils in thickness.
- 2. Basis of Design: Amerete, Inc.; CreteClad.

2.05 POLISHING EQUIPMENT

- A. Field Grinding and Polishing Equipment:
 - 1. Variable speed, 3 or 4 head counter-rotating, walk-behind machine with not less than 600 lbs of down pressure on grinding or polishing pads.
 - 2. Dust extraction equipment with flow rate suitable for dust generated, with pre-separator and squeegee attachments.
- B. Edge Grinding and Polishing Equipment: Hand-held or single head walk-behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.
- C. Burnishing Equipment: Single head high speed walk-behind machines.
- D. Grinding Pads: Metal bonded pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- E. Polishing Pads: Resin bonded pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.
- F. Burnishing Pads: Maintenance pads coated with embedded industrial grad diamonds for use with burnishing equipment.

2.06 CONCRETE MIX DESIGN

- A. Material Quality Standards: Mix designs for each type and strength of concrete used for floors will be prepared as specified in appropriate Division 03 Section, with following qualifications:
 - 1. Slump Limit: 4 inches, plus or minus 1 inch.
 - 2. Maximum Water-Cement Ration: 0.45.
 - 3. Air Content: No permitted.
 - 4. Admixtures: Calcium chloride based compounds not permitted.

PART 3 EXECUTION

3.01 ACCEPTABLE POLISHERS

A. Basis of Design: Contract Documents are based on polishing operations by Amerete, Inc. to establish a standard of quality. Other polished with products and polishing capabilities having equivalent characteristics may be considered, provided deviations are minor and do not change concept expressed in Contract Documents as judged by Architect.

3.02 EXAMINATION

- A. Plan joint pattern layout; coordinate slab dimensions and construction joint locations with concrete installer.
- B. Verify that floor surfaces are acceptable to receive the work of this section.
- C. Acceptance of Surfaces and Conditions: Examine substrates to be polished for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

3.03 PREPARATION

- A. Preparation For Application:
 - 1. Ensure concrete is a minimum of 28 days old.
 - 2. Remove all dirt, form oil, plaster or mortar residue, water repellants, or adhesives completely and in a manner which will not alter surface texture uniformity.
 - 3. If curing compounds or other residue cannot be removed completely by hand cleaning, remove with a terrazzo grinder. Do not sandblast surfaces to be sealed.
 - Pressure wash and rinse all surfaces completely using methods approved by the manufacturer.
 - 5. Do not acid wash or use heavy alkali cleaners.
 - 6. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, and other contaminants incompatible with polished concrete floor finish.

3.04 PLACING AND FINISHING CONCRETE FOR FLOORS

- A. General: Comply with appropriate Division 03 Section.
- B. Hot and Cold Weather Placement: As specified in appropriate Division 03 Section.
- C. Placement: Deposit and consolidate concrete in continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Screed slab surfaces with a straight edge and strike off to correct elevations.
 - 3. After screeding, consolidating and leveling, do not work surface until ready for floating.

D. Float Finishing:

- 1. Begin floating operations when water sheen has disappeared, and/or when concrete has stiffened sufficiently to permit proper operation of power-driven equipment.
- 2. Consolidate surface with power-driven troweling using steel float pans.
- Hand float with wood or cork faced floats in locations inaccessible to power-driven machine.
- 4. Level surface using 10 foot highway straight edge.
- 5. Cut down high spots and fill low spots to produce planes checking true under straightedge in any direction.
- 6. Bring surface to uniform, smooth, granular texture with power-driven troweling using steel float pans.
- E. Joints: Saw cut of tool joints to match approved mock-up.
- F. Moisture Curing: Immediately begin after floating.

- G. Keep concrete surface continuously wet by covering with absorptive cover or by using continuous water-fog spray.
- H. Cover concrete surface with absorptive cover with 4 inch lap over adjacent absorptive covers.
- . Thoroughly saturate cover with water and keep continuously wet.

3.05 CONCRETE POLISHING

- A. Initial Grinding:
 - Use grinding equipment and low grit grinding pads.
 - Grind concrete to specified aggregate exposure imparting uniform scratch pattern in concrete.
 - 3. Vacuum floor using squeegee vacuum attachment.

B. Level of Grinding:

- Description: Minimally grind concrete without removing the cement cream leaving surface
 of uniform color matching approved mock-up.
- 2. Basis of Design: Amerete, Inc.; Luxcrete Basic.

C. Treating Surface Imperfections:

- 1. Match patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface.
- 2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids.
- 3. Work compound and treatment until color difference between concrete surface and filled surface imperfections are not noticeable.

D. Grout Grindina:

- 1. Use grinding equipment and appropriate grit grinding pads.
- 2. e applying fresh grout material prior to, grind concrete in direction perpendicular to initial grinding to remove scratches.
- 3. Vacuum floor using squeegee vacuum attachment.

E. Additional Grinding:

- 1. Use grinding equipment and increasing finer grit grinding pads.
- 2. Grind concrete in as many passes necessary with each pass perpendicular to previous pass to remove scratches.
- 3. Vacuum floor using squeegee vacuum attachment.

F. Polishing:

- 1. Use polishing equipment and increasing finer grip polishing pads.
- Polish concrete in as many passes necessary with each pass perpendicular to previous pass to remove scratches.
- 3. Vacuum floor using squeegee vacuum attachment.
- G. Applying Polish Guard: Uniformly apply and remove excessive liquid.
- H. Applying Final Polish: Using burnishing equipment and finest grit burnishing pads, burnish to uniform sheen matching approved mock-up
 - 1. Final Polished Sheen: Uniform semi-gloss sheen using 1500 grit polishing heads.

3.06 FIELD QUALITY CONTROL

A. Static Coefficient of Friction Testing: Retain Walkway Auditor to test polished finishes according to NFSI 101-A to confirm compliance with specified static coefficient of friction.

3.07 PROTECTION

A. Covering: Protect polished finish work from subsequent construction with protective covering.

END OF SECTION

SECTION 04 2000 UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Nailing strips built into masonry.
- B. Section 07 9005 Joint Sealers

1.03 REFERENCE STANDARDS

- A. TMS 402/602 Building Code Requirements and Specification for Masonry Structures; 2016.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A580/A580M Standard Specification for Stainless Steel Wire; 2016.
- D. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM A951/A951M Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016.
- F. ASTM C90 Standard Specification for Loadbearing Concrete Masonry Units; 2016.
- G. ASTM C91/C91M Standard Specification for Masonry Cement; 2012.
- H. ASTM C140/C140M Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2016.
- ASTM C144 Standard Specification for Aggregate for Masonry Mortar; 2011.
- J. ASTM C150/C150M Standard Specification for Portland Cement; 2016.
- K. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- L. ASTM C270 Standard Specification for Mortar for Unit Masonry; 2014a.
- M. ASTM C404 Standard Specification for Aggregates for Masonry Grout; 2011.
- N. ASTM C476 Standard Specification for Grout for Masonry; 2016.
- O. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2016a.
- P. BIA Technical Notes No. 7 Water Penetration Resistance Design and Detailing; 2005.
- Q. BIA Technical Notes No. 13 Ceramic Glazed Brick Exterior Walls; 2017.
- R. TMS 402/602 Building Code Requirements and Specification for Masonry Structures; 2016.
- S. BIA Technical Notes No. 7 Water Penetration Resistance Design and Detailing; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

Refer to Owner's General Conditions and Special Conditions, for submittal procedures.

- B. Product Data: Provide data for masonry units, mortar, and masonry accessories.
- C. Samples: Submit one sample of decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Glazed Units: 10 of each type, size, and color combination.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store pre-faced concrete block units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
 - 2. Special Shapes: Provide non-standard blocks configured for corners.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - b. Pattern: Running bond..

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Hohmann & Barnard, Inc; : www.h-b.com/#sle.
 - 2. Substitutions: See Section 01 6000 Product Requirements.
- B. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - Material: stainless steel complying with ASTM A580/A580M Type 304.
 - 3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- C. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder, with adjustable ties or tabs spaced at 16 in (406 mm) on center.
 - 2. Material: stainless steel complying with ASTM A580/A580M Type 304.
 - 3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods and adjustable components of 0.1875 inch (4.8 mm)wire, width of components as required to provide not less than 5/8 inch (16 mm) of mortar coverage from each masonry face.

- 4. Type: Hohmann & Barnard: Tie-HVR-295 Anchor System or equivalent.
- D. Single Wythe Joint Reinforcement: Ladder type; 1 steel wire, hot dip galvanized after fabrication to 2, Class B; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.

2.04 FLASHINGS

A. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch (0.48 mm) thick; finish 2B to 2D.

2.05 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
- B. Weeps:
 - 1. Type: Polyester mesh.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, loadbearing masonry: Type N.
 - 3. Interior, loadbearing masonry: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

 Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

- Establish lines, levels, and coursing indicated. Protect from displacement.
- Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - Mortar Joints: Concave.

3.05 PLACING AND BONDING

- Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.

3.09 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

3.10 LINTELS

A. Install loose steel lintels over openings.

3.11 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide and deep.

3.12 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - Fill adjacent masonry cores with grout minimum 12 inches (300 mm) from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.13 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).

3.14 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 FIELD QUALITY CONTROL

- A. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- B. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.16 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.17 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 4313 STONE MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Anchored field stone veneer at exterior and interior walls.
- B. Metal anchors and accessories for anchored veneer.
- C. Setting mortar and pointing mortar.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry: Joint reinforcement, Ties, Anchors, and Through-wall flashing.
- B. Section 07 9200 Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A580/A580M Standard Specification for Stainless Steel Wire; 2016.
- C. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM C119 Standard Terminology Relating to Dimension Stone; 2019.
- E. ASTM C270 Standard Specification for Mortar for Unit Masonry; 2014a.
- F. ASTM C1528/C1528M Standard Guide for Selection of Dimension Stone; 2018.
- G. ASTM C1714/C1714M Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2016.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide data on stone units, _____, mortar, and reinforcement.
- C. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, _____, color range, texture, and markings.
- D. Samples: Submit mortar color samples.
- E. Stone Fabricator's Qualification Statement.
- F. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum five years of documented experience.

1.06 MOCK-UP

- A. Construct stone wall mock-up, 5 feet (____ m) long by 5 feet (____ m) wide; include stone anchor accessories, corner condition, and typical control joint in mock-up. Include in bid cost of constructing 3 sample panels. Mortar color and jointing will be reviewed after initial sample panel construction. Adjustments in mortar or joint treatment may be made before construction of subsequent sample panels.
- B. Locate where directed.
- C. Protect accepted sample panel. Accepted sample panel establishes level of quality for remainder of project.
- D. Remove rejected and accepted sample panels when directed by architect.

1.07 DELIVERY, STORAGE, AND HANDLING

- Protect stone from discoloration during storage on site.
- B. Provide ventilation to prevent condensation from forming on stone.

1.08 FIELD CONDITIONS

A. Maintain materials and ambient air at minimum of 40 degrees F (5 degrees C) prior to, during, and for 48 hours after completion of work.

PART 2 PRODUCTS

2.01 STONE

- A. Stone: San Saba Moss Rock type,
 - Surface Finish: Natural Cleft; as described in ASTM C119 and ASTM C1528/C1528M.

2.02 MORTAR APPLICATIONS

- A. Field-mix all mortar.
- B. Mortar Color: As selected by architect.
- C. Pointing Mortars: Pointing or grouting mortars used to fill the joints between individual stone veneer units once the setting bed mortar has sufficiently cured.
 - 1. Site-Mixed: ASTM C270, Type N, using the Property Method in ASTM C270.

2.03 MORTAR MIXES

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Types as scheduled in this section.
 - Color: Mineral pigments added as required to produce approved color sample.
 - Manufacturers:
 - a. Amerimix, an Oldcastle brand; ____: www.amerimix.com/#sle.
 - b. The QUIKRETE Companies; ____: www.quikrete.com/#sle.
 - Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.04 ACCESSORIES - ANCHORED VENEER

- A. Wall Ties: Formed steel wire, at least 3/16 inch (___ mm) diameter, stainless steel complying with ASTM A580/A580M, eye and pintle type, with provision for vertical adjustment after attachment.
- B. Flashings: As specified in Section 04 2000.
- C. Weep/Cavity Vents: Molded PVC grille, insect resistant.
- D. Cavity Wall / Veneer Drainage Net: 90% open mesh random spun, bonded high density polyethlene; 10 inches high X 60 inched long X 1 inch thick; green color; Mortar Net manufactured by Mortar Net USA, Ltd.
- E. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.05 STONE FABRICATION - ANCHORED VENEER

- A. Nominal Thickness: 4 inch (____ mm).
- B. Nominal Face Size: 6x18 inch (___ mm) maximum, 3x9 minimum, stone to generally be 1:3 proportion.
- C. Pattern and Coursing: Random Ashlar running horizontal.
- D. Fabricate for 3/8 inch (10 mm) beds and joints.
- E. Bed and Joint Surfaces:
 - Chopped roughly to size
- F. Backs: Rough or split.

- G. Form stone corners to irregular joint profile. Clean jagged corners from stone in preparation for setting.
- H. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this section.
- B. Verify that items built-in under other sections, including through wall flashing, are properly located and sized.

3.02 PREPARATION - ANCHORED VENEER

- A. Establish lines, levels, and coursing. Protect from disturbance.
- B. Clean stone prior to installation. Do not use wire brushes or implements that mark or damage exposed surfaces.
- C. Clean sawn surfaces of dust, rust stains and iron particles.
- D. Place cavity wall / veneer drainage net in air space at base of walls. Tightly butt sections of cavity wall / veneer drainage net. Where cavity is wider than 1 inch, provide multiple thicknesses of drainage new to fully fill cavity.

3.03 INSTALLATION - ANCHORED VENEER

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joints minimum 6 inches (150 mm) and seal watertight.
- B. Size stone units to fit opening dimensions and perimeter conditions.
- C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.
- D. Arrange stone pattern to provide color uniformity and minimize visual variations, and provide a uniform blend of stone unit sizes.
- E. Arrange stone coursing in random ashlar bond with consistent joint width.
- F. Install weep/cavity vents in vertical stone joints at 24 inches (____ mm) on center horizontally; immediately above horizontal flashings, above shelf angles and supports, and at top of each cavity space; do not permit mortar accumulation in cavity space.

3.04 REINFORCEMENT AND ANCHORAGE - ANCHORED VENEER

- A. Embed wall ties in masonry back-up to bond veneer to back-up at maximum 16 inches (400 mm) on center vertically and 32 inches (_____ mm) on center horizontally.
- B. In addition, place wall ties at maximum 12 inches (_____ mm) on center each way around perimeter of openings, within 12 inches (300 mm) of openings.

3.05 JOINTS - ANCHORED VENEER

- A. Leave the following joints open for sealant specified in Section 07 9200:
 - 1. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
 - 2. Joints below ledge and relieving angles.
 - 3. Joints labeled "expansion joint".
 - 4. Joints between stone and adjacent walls. Provide 3/8 inch joint.
- B. Rake out mortar joints 5/8 to 3/4 inch (16 to 19 mm) and brush joints clean to accommodate pointing mortar. Fill joints with pointing mortar.
- C. Pack mortar into joints and work into voids. Neatly tool surface to concave joint.
- D. At joints to be sealed, clean mortar out of joint before it sets. Brush joints clean.

3.06 INSTALLATION - MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

- B. Extend metal flashings through exterior face of stone and terminate in an angled drip with hemmed edge.
- C. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.07 CLEANING

- A. Remove excess mortar as work progresses, and upon completion of work.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

3.08 PROTECTION

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION

SECTION 04 7200 CAST STONE MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural cast stone.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry: Installation of cast stone in conjunction with masonry.
- B. Section 07 9200 Joint Sealants: Sealing joints indicated to be left open for sealant.

1.03 REFERENCE STANDARDS

- ACI 318 Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- B. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2016.
- D. ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009 (Reapproved 2015).
- E. ASTM A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2016.
- F. ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.
- G. ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2017.
- H. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2016.
- I. ASTM C150/C150M Standard Specification for Portland Cement; 2016.
- J. ASTM C270 Standard Specification for Mortar for Unit Masonry; 2014a.
- K. ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete; 2016.
- L. ASTM C1364 Standard Specification for Architectural Cast Stone; 2016.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Test results of cast stone components made previously by the manufacturer.
- C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
- D. Verification Samples: Pieces of actual cast stone components not less than 12 inches (305 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - Current producer member of the Cast Stone Institute or the Architectural Precast Association.
 - 2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.
- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

PART 2 PRODUCTS

2.01 ARCHITECTURAL CAST STONE

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural San Saba Moss Rock, complying with ASTM C1364.
 - 1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
 - 2. Freeze-Thaw Resistance: Demonstrated by field experience.
 - 3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
 - 4. Color: Selected by Architect from manufacturer's full range.
 - 5. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Provide shapes indicated on drawings.
 - 1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
 - 2. Unless otherwise indicated on drawings, provide:
 - a. Wash or slope of 1:12 on exterior horizontal surfaces.
 - b. Drips on projecting components, wherever possible.
 - c. Raised fillets at back of sills and at ends to be built in.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

2.02 MATERIALS

- A. Portland Cement: ASTM C150/C150M.
 - 1. For Units: Type I or II, white.
 - 2. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized or epoxy coated.
 - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
 - 2. Epoxy coated in accordance with ASTM A775/A775M.
- G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Shelf Angles and Similar Structural Items: Hot-dip galvanized steel per ASTM A123/A123M, of shapes and sizes as required for conditions.

- J. Mortar: Portland cement-lime, ASTM C270, Type N; do not use masonry cement.
- K. Sealant: As specified in Section 07 90 05
- L. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

PART 3 EXECUTION

3.01 INSTALLATION

- Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.
- B. Mechanically anchor cast stone units indicated; set remainder in mortar.
- C. Setting:
 - 1. Drench cast stone components with clear, running water immediately before installation.
 - 2. Set units in a full bed of mortar unless otherwise indicated.
 - 3. Fill vertical joints with mortar.
 - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- D. Sealant Joints: Install Sealants as specified in Section 07 90 05.

3.02 TOLERANCES

- A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
 - 1. Rake mortar joints 3/4 inch (19 mm) for pointing.
 - 2. Remove excess mortar from face of stone before pointing joints.
 - 3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
 - 4. Leave the following joints open for sealant:
 - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
 - b. Joints in projecting units.
 - c. Joints between rigidly anchored units, including soffits, panels, and column covers.
 - d. Joints below lugged sills and stair treads.
 - e. Joints below ledge and relieving angles.
 - f. Joints labeled "expansion joint".

B. Installation Tolerances:

- 1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
- 2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
- 3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
- 4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.03 REPAIR

- Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
- B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
- C. Repair methods and results subject to Architect 's approval.

3.04 CLEANING

A. Keep cast stone components clean as work progresses.

3.05 PROTECTION

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

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. Structural steel.
- 2. Prefabricated building columns.
- 3. Shear stud connectors.
- 4. Shrinkage-resistant grout.

B. Related Requirements:

- 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
- Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
- 3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
- 4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.
- 5. Section 133419 "Metal Building Systems" for structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.

- D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.4 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 anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

- 1. Structural-steel materials.
- 2. High-strength, bolt-nut-washer assemblies.
- 3. Shear stud connectors.
- 4. Anchor rods.
- 5. Threaded rods.
- 6. Forged-steel hardware.
- 7. Slide bearings.
- 8. Prefabricated building columns.
- 9. Shop primer.
- 10. Galvanized-steel primer.
- 11. Etching cleaner.
- 12. Galvanized repair paint.
- 13. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand-critical welds.

- 8. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

 Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - ANSI/AISC 341.
 - ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
 - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type PR, partially and Type FR, fully restrained.
- D. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M or ASTM A572/A572M, Grade 50.

- B. Channels, Angles: ASTM A36/A36M or ASTM A572/A572M, Grade 50.
- C. Plate and Bar: ASTM A36/A36M or ASTM A572/A572M, Grade 50.
- D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, 50 ksi.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- F. Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections: ASTM A847/A847M structural tubing.
- G. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 - 1. Weight Class: Standard, Extra strong, Double-extra strong.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- I. Steel Forgings: ASTM A668/A668M.
- J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable.
 - 1. Configuration: Straight, Hooked.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- B. Headed Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- C. Threaded Rods: ASTM A36/A36M or ASTM A572/A572M, Grade 50.
 - 1. Nuts: ASTM A63 heavy-hex carbon steel.
 - 2. Washers: ASTM A36/A36M carbon steel.
 - 3. Finish: Plain.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
 - 2. SSPC-Paint 23, latex primer.
 - 3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#26, MPI#80, MPI#134.
 - 1. Etching Cleaner: MPI#25, for galvanized steel.
 - 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces.

- 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
- 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 - 4. SSPC-SP 14 (WAB)/NACE WAB-8.
 - 5. SSPC-SP 11.
 - 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 - 7. SSPC-SP 10 (WAB)/NACE WAB-2.

- 8. SSPC-SP 5 (WAB)/NACE WAB-1.
- 9. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 - 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 - 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

- 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," Section 099600 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

- a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 1200

SECTION 05 5200 HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Painted Galvanized steel handrails, balusters, and fittings.

1.02 RELATED SECTIONS

- A. Section 03 30 00 Cast-in-Place Concrete: Placement of anchors in concrete
- B. Section 05 1200 Structural Steel Framing: Galvanizing
- C. Section 09 9000 Paints and Coatings

1.03 REFERENCE STANDARDS

- A. ASTM E935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- B. ASTM E985 Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

1.04 DESIGN REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E 985 and applicable local code.
- B. Hand rail shall be designed and equipped with full provisions for horizontal and vertical adjustment as well as for thermal expansion and contraction of railings.
- C. Fabricate railing assembly, wall rails, and attachments in accordance with ASTM E 985.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Manufacturer/Fabricator shall submit evidence of satisfactory completion of similar work during a minimum period of 15 years in business. Engineer reserves the right to require financial disclosure and inspect fabrication facilities in determining qualifications.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- D. Samples: Submit two, 6 inch long samples of handrail. Submit two samples of wall bracket and railing grid panel showing typical shop welded joint.

1.06 QUALITY ASSURANCE

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation
- B. Field welding of railing grilles and panels, or of railing panel to vertical and horizontal railings or to posts is completely unacceptable.
- Welders employed to fabricate railings shall have passed qualification tests within the preceding 12 months in the position for which qualified, using test procedures covered in the AWS D1.1-80
- D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, to ensure fitting of work. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work only upon written approval from engineer.

PART 2 - PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

- B. Concentrated Loads: Design railing assembly, wall railing, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set.
- Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

- A. Hot-dipped galvanized Steel Plates, Shapes and Bars. Where bars are indicated, furnish solid units with sharp unradiused corners.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- C. Fittings: Elbows, T-shapes, wall brackets, escutcheons; Hot-dipped galvanized steel.
- D. Concealed Fasteners: Hot-dipped galvanized screws or bolts; consistent with design of railing.

2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Provide anchors and plates required for connecting railings to structure.
- E. Exposed Mechanical Fastenings: Provide flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
- H. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
- I. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- J. Accurately form components to suit specific project conditions and for proper connection to building structure.
- K. Accommodate for expansion and contraction of members and building movement without damage to connections or members.
- L. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without swelling, buckling, twisting or otherwise deforming exposed surfaces of handrail and railing components. Railing panel and grille configurations shall follow the curvature indicated for the handrail.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
- B. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.
- C. Clan and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.04 FABRICATION AND ERECTION TOLERANCES

- A. Machine, field and shop assemble joints to fit within 1/32+/-. Install freestanding item to +/- 1/8" of indicated position, plumb and level. Size of each element of an assembly shall be correct within 1/8"; curved element maximum +/- 1/8" on the chord rise and maximum +/- 1/4" in chord length.
- B. Maximum Variation From Plumb: 1/4 inch in four feet.
- C. Maximum Offset From True Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 1000 ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Roofing nailers.
- D. Preservative treated wood materials.
- E. Fire retardant treated wood materials.
- F. Miscellaneous framing and sheathing.
- G. Communications and electrical room mounting boards.
- H. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 07 6100 Sheet Metal Roofing
- B. Section 07 6200 Sheet Metal Flashing and Trim: Sill flashings.
- C. Section 09 2116 Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. AWC (WFCM) Wood Frame Construction Manual for One- and Two-Family Dwellings; 2015.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM C557 Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).
- D. ASTM D2898 Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- E. ASTM D3498 Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2018a.
- F. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. AWPA U1 Use Category System: User Specification for Treated Wood; 2012.
- H. PS 1 Structural Plywood; 2009.
- I. PS 2 Performance Standard for Wood-Based Structural-Use Panels; 2010.
- J. PS 20 American Softwood Lumber Standard; 2010.
- K. SPIB (GR) Grading Rules; 2014.

1.04 DEFINITIONS

- A. Dimensional Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimensions.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.05 SUBMITTALS

A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.

- B. Product Data: Provide technical data on wood preservative materials, application instructions, and fire retardant materials.
- C. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- D. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: Kiln-dry or MC15.
- D. Stud Framing (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm)):
 - 1. Species: Any allowed under referenced grading rules.
 - 2. Grade: No. 2.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.
 - Preservative treat blocking, furring, and nailers associated with roofing and waterproofing assemblies.

2.03 EXPOSED DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

- B. Sizes: Nominal sizes as indicated on drawings.
- C. Surfacing: S4S.
- D. Moisture Content: S-dry or MC19.
- E. Stud Framing (2 by 2 through 2 by 6 (50 by 50 through 50 by 150 mm)):
 - 1. Species: Western Cedar.
 - 2. Grade: Clear.
- F. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 (50 by 150 through 100 by 400 mm)):
 - 1. Species: Douglas Fir.
 - 2. Grade: Clear.

2.04 CONSTRUCTION PANELS

- A. Wall Sheathing: Any PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: 5/16 PERF CAT.
 - 5. Edge Profile: Square edge.
- B. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Structural 1 Sheathing.
 - 2. Bond Classification: Exposure 1.
 - 3. Performance Category: 5/8 PERF CAT.
 - 4. Span Rating: 40/20.
 - 5. Edges: Square.
 - 6. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.
 - 7. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches (406 mm) and 24 inches (610 mm) on center, respectively.
 - 8. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
 - 9. Manufacturers:
 - a. Huber Engineered Woods, LLC; AdvanTech Sheathing: www.huberwood.com/#sle.
 - b. Substitutions: [See Owner's General Conditions and Special Conditions]
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.05 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Slip sheet: High temperature rated, self-adhering, polyethylene faced bituminous membrane; 30-40 mills thickness, width as required.
- C. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.

2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:

- 1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated .
 - Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:

- 1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to .25 lb/cu ft retention (to ____ kg/cu m retention).
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.
 - d. Treat lumber in contact with masonry or concrete.
- 2. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative to 0.31 lb/cu ft retention (to 5 kg/cu m retention).
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific non-structural framing and blocking:
 - Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.03 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.
- C. Avoid contact between preservative treated wood materials with galvanized deck. In such applications, provide a self-adhering membrane separation sheet between galvanized deck and wood.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size and Location: As indicated on drawings.

3.05 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.06 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.07 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 01 7419 Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 061516

WOOD ROOF DECKING

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 solid-sawn wood roof decking
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.
 - 2. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
- B. Samples: 24 inches long, showing the range of variation to be expected in appearance of wood roof decking.

1.4 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood

roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 SOLID-SAWN WOOD ROOF DECKING

- A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.
- B. Roof Decking Species: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), hem-fir, hem-fir (North), southern pine, spruce pine-fir (North), western hemlock, or western hemlock (North).
- C. Roof Decking Species: Douglas fir-larch or Douglas fir-larch (North).
- D. Roof Decking Nominal Size: 3 by 6 and 4 by 6.
- E. Roof Decking Grade: No 2 or better.
- F. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- G. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- H. Face Surface: Smooth.
- Edge Pattern: Vee grooved.

2.3 PRESERVATIVE TREATMENT

- A. Pressure treat wood roof decking according to AWPA U1; Use Category UC2.
 - 1. For laminated roof decking, treat lumber before gluing.
- B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 1. For exposed items indicated to receive a stained or natural finish, use products that do not contain colorants, bleed through, or otherwise adversely affect finishes.
- C. Use process that includes water-repellent treatment.
- D. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.

- E. After treatment, redry materials to 19 percent maximum moisture content.
- F. After dressing and fabricating roof decking, apply inorganic boron according to AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.4 ACCESSORY MATERIALS

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- C. Nails: Common; complying with ASTM F1667, Type I, Style 10.
- D. Spikes: Round; complying with ASTM F1667, Type III, Style 3.
- E. Fastener Material: Hot-dip galvanized steel.
- F. Bolts for Anchoring Roof Decking to Walls: Carbon steel; complying with ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers, all hot-dip zinc coated.
- G. Installation Adhesive: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide adhesive that complies with research/evaluation report.
- H. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - c. <u>Pecora Corporation</u>.
 - d. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
 - e. Tremco Incorporated.
- I. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

2.5 FABRICATION

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.
- B. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- C. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.
- D. Apply indicated finish materials to comply with Section 099300 "Staining and Transparent Finishing" in fabrication shop.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid-sawn wood roof decking to comply with AITC 112.
 - 1. Locate end joints for lay-up indicated.
- B. Install laminated wood roof decking to comply with manufacturer's written instructions.
 - 1. Locate end joints for lay-up indicated.
 - 2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.
 - a. Use 12d nails for 2-by-6 and 2-by-8 roof decking.
 - b. Use 30d nails for 3-by-6 and 3-by-8 roof decking.
 - c. Use 60d nails for 4-by-6 and 4-by-8 roof decking. Predrill roof decking to prevent splitting.
 - d. Use 30d tongue nails in bottom tongue and 3/8-inch face spikes for 5-by-6 and 5-by-8 roof decking. Predrill roof decking at spikes to prevent splitting.
 - 3. Slant nail each course of glued-laminated wood roof decking to the tongue of the adjacent course at 30 inches o.c. and within 12 inches of the end of each unit. Stagger nailing 15 inches in adjacent courses.
 - a. Use 8d nails for 3-by-6 and 3-by-8 roof decking.
 - b. Use 10d nails for 4-by-6 and 4-by-8 roof decking.
 - c. Use 16d nails for 5-by-6 and 5-by-8 roof decking.
 - 4. Glue adjoining roof decking courses together by applying a 3/8-inch bead of adhesive to the top of tongues, according to research/evaluation report.
- C. Anchor wood roof decking, where supported on walls, with bolts as indicated.
- D. Where preservative-treated roof decking must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
 - 1. For solid-sawn roof decking, use inorganic boron (SBX).
 - 2. For laminated roof decking, use copper naphthenate.
- E. Apply joint sealant to seal roof decking at exterior walls at the following locations:
 - 1. Between roof decking and supports located at exterior walls.
 - 2. Between roof decking and exterior walls that butt against underside of roof decking.
 - 3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.
- B. If, despite protection, roof decking becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061516

SECTION 06 1753

SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
 - 2. Wood floor trusses.
 - Wood girder trusses.
- B. Related Requirements:
 - 1. Section 313116 "Termite Control" for site application of borate treatment to wood trusses.

1.3 ALLOWANCES

A. Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."

1.4 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.

- 2. Indicate sizes, stress grades, and species of lumber.
- 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
- 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
- 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
- 6. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated lumber.
 - 2. Fire-retardant-treated wood.
 - 3. Metal-plate connectors.
 - Metal truss accessories.

1.7 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fireretardant-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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.
 - 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: as indicated.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
 - 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
 - 3. CompuTrus, Inc.
 - 4. Eagle Metal Products.
 - 5. Jager Building Systems, Inc.
 - 6. MiTek Industries. Inc.
 - 7. Robbins Engineering, Inc.
 - 8. Truswal Systems Corporation.
- B. Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, and not less than 0.035 inch thick.
 - 1. Use for exterior locations and where indicated.

2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 - 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.

- 3. Phoenix Metal Products, Inc.
- 4. Simpson Strong-Tie Co., Inc.
- 5. USP Structural Connectors.
- B. Allowable design loads, as published by manufacturer, shall comply with or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
 - 1. Use for exterior locations and where indicated.
- F. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of truss and fastens to both sides of truss, top plates, and one side of stud below.
- G. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches wide by 0.050 inch thick. Clip is fastened to truss through slotted holes to allow for truss deflection.
- H. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.
- I. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.
 - 1. Angle clip is 3 by 3 by 0.179 by 8 inches with extended leg 8 inches long. Connector has galvanized finish.
 - 2. Angle clip is 3 by 3 by 0.239 by 10-1/2 inches with extended leg 10-1/2 inches long. Connector has painted finish.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.7 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.8 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 - Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.

- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
 - Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
 - Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 06 1753

SECTION 06 1800

GLUED-LAMINATED CONSTRUCTION

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. Framing using structural glued-laminated timber.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
 - 2. Section 061300 "Heavy Timber Construction" for framing using timbers and round wood poles.
 - 3. Section 061516 "Wood Roof Decking" for glued-laminated wood roof decking.

1.3 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 3. For connectors. Include installation instructions.

B. Shop Drawings:

- 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
- 2. Indicate species and laminating combination.
- 3. Include large-scale details of connections.

- C. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber including variations due to specified treatment.
 - 1. Apply specified factory finish to three sides of half length of each Sample.
- D. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.
- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D3737 and acceptable to authorities having jurisdiction.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 - 2. Provide structural glued-laminated timber made from single species.
 - 3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

- 4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
- B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch or Southern pine that complies with structural properties and beam stress classifications indicated.
- C. Appearance Grade: Architectural or Premium, complying with AITC 110.
 - 1. For Premium and Architectural appearance grades, fill voids as required by AITC 110. For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.

2.3 PRESERVATIVE TREATMENT

- A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 1 at interior and Category 3A at exterior.
 - 1. Use preservative solution without water repellents or substances that might interfere with application of indicated finishes.
 - 2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.
- B. Preservative: One of the following:
 - 1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
 - 2. Pentachlorophenol in light petroleum solvent.
 - 3. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
- C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.4 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Simpson Strong-Tie Co., Inc.
- B. Fabricate beam seats from steel with 3/8-inch bearing plates, 3/4-inch- diameter-by-12-inch-long deformed bar anchors, and 0.239-inch side plates.
- C. Fabricate hinge connectors from steel with 0.179-inch side plates and 3/4-inch top and bottom plates.
- D. Fabricate strap ties from steel, 3 inches wide by 0.239 inch thick.
- E. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A668/A668M.
- F. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.
- G. Provide shear plates as shown on drawings.

- H. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
 - 2. Round steel bars complying with ASTM A575, Grade M 1020.
 - 3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
 - 4. Stainless steel flat bars complying with ASTM A666, Type 304.
 - 5. Stainless steel bars and shapes complying with ASTM A276, Type 304.
 - 6. Stainless steel plate, sheet, and strip complying with ASTM A240/A240M or ASTM A666, Type 304.
- I. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- J. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.5 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
 - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.
 - 1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - 2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.7 FACTORY FINISHING

- A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
 - 1. Color: Match Architect's sample.
- B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, 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. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches; and do not embed more than 4 inches unless otherwise indicated.
- C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 3. Coat cross cuts with end sealer.
 - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

- E. Install timber connectors as indicated.
 - Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
 - 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 06 1800

SECTION 06 2000 FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 Cabinets and Casework: Shop fabricated custom cabinet work.
- C. Section 09 9000 Paints and Coatings: Painting and finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 American National Standard for Particleboard: 2009.
- B. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
- C. BHMA A156.9 American National Standard for Cabinet Hardware; 2010.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions for submittal procedures.
- B. Product Data: Provide data on finish material.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of wood trim 12 inch (304 mm) long.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage and humidity.

1.08 PROJECT CONDITIONS

- A. Protect work from moisture damage.
- B. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Custom Grade.
- B. Exterior Woodwork Items:
 - 1. Fascias: Prepare for preservative stain finish
 - Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Douglas-Fir; prepare for clear finish.
 - 2. Closet Shelving: Particleboard laminated with Melamine.

2.02 SHEET MATERIALS

A. Particleboard: ANSI A208.1; Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.03 PLASTIC LAMINATE MATERIALS

- A. Low Pressure Laminate: Melamine; White color, _____ pattern and matte surface texture.
- B. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.04 FASTENINGS

A. Concealed Joint Fasteners: Threaded steel.

2.05 ACCESSORIES

- A. Asphalt-saturated organic felt conforming to the requirements of ASTM D226, type II (No.30).
 - 1. Provide where wood elements touch concrete or masonry.
- B. Clear Finish: as specified in Section 09 9000.
- C. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 HARDWARE

- A. Hardware: Comply with BHMA A156.9.
- B. Shelf Standards: Adjustable style, ANO finish; 85 manufactured by Knape and Vogt.
- C. Shelf Brackets: Adjustable style, ANO finish; 185 manufactured by Knape and Vogt.

2.07 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- C. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)

2.08 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Prime paint surfaces in contact with cementitious materials.
- E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

- Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

 Install work in accordance with AWI/AWMAV/WI Architectural Standards requirements for grade indicated.

- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 INSTALLATION - BASE

- Distribute defects allow in quality grades specified to the best overall advantage. Refer uncertainties to Architect.
- B. Install in a single unjointed length for runs less than maximum length of lumber available. For longer runs, use pieces which average a minimum of three feet less than maximum length available.
- C. Cope at inside corners and miter at outside corners to produce tight fitting joints with full surface contact throughout length of joint. Use scarf joints for end-to-end joints. Maintain field joint tolerance equal to those specified in AWI Standards for shop prepared joints.
- D. Blind nail where possible and use fine finishing nails where exposed. Pre-drill as required to eliminate splitting. Set exposed nailheads and fill flush, matching final finish where transparent finish is indicated.
 - 1. Install base with double nails at 8 inches on center maximum spacing.

3.04 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 9000.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.05 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch (1.5 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

3.06 CLEANING AND PROTECTION

- A. Clean finish carpentry work on exposed and semi-exposed surfaces. Touch-up and sand only as required to restore damaged, abraded, or soiled areas.
- B. Protection: Installer of finish carpentry work shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION

SECTION 06 4100 CABINETS AND CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Special fabricated cabinet units.
- B. Hardware.
- C. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 2000 Finish Carpentry
- C. Section 12 3600 Solid Surface Countertops
- D. Section 12 3600 Countertops.
- E. Section 09 9000 Paints and coatings.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. NEMA LD 3 High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, hardware location and schedule of finishes.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet and shelf unit substrate and finish.
- E. Samples: Submit two panels, 12 x 12 inch in size, illustrating cabinet finish.
- F. Samples: Submit two samples of proposed drawer pulls, hinges, and shelf standards, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Premium quality.
- B. Manufacturer Qualifications: Company specializing in fabricating the products specified in this section with minimum three years of documented experience.

1.07 MOCK-UP

- A. Provide mock-up of full size face frame and door for cabinet, including hardware and finish.
- B. Mock-up may not remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

B. Do not deliver casework to the site until doors and windows are installed and temperature and humidity control can be assured. Maintain minimum temperature of 60 degrees F and relative humidity between 25 and 55 percent for not less than 2 days prior to delivery of millwork and for the remainder of the construction period. Place casework in areas where it will be installed and allow to acclimate for not less than 48 hours before beginning installation.

1.09 FIELD CONDITIONS

A. During and after installation of cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

2.02 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.03 COUNTERTOPS

A. Countertops are specified in Section 12 3600.

2.04 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Concealed Joint Fasteners: Threaded steel.
- D. Grommets: Standard one-piece, round, epoxy-coated metal grommets for cut-outs, in color as scheduled.
 - 1. Size: For 2-1/2 inch (63 mm) opening.
 - 2. Product: Metal Cable Grommet, Item No.429.94.346, as manufactured by Hafele. www.hafele.com
 - a. Finish: Black Epoxy
 - 3. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.05 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
- B. Hardware Finish: Provide Satin chrome steel.
- C. Shelf standards: Knape & Vogt #255 Series Steel.
- D. Shelf Support Clip: Knape & Vogt #256 Series Steel.
- E. Drawer and Door Pulls: U shaped, steel drawer pull; overall length of 4-3/8" with 1" projection..
 - 1. Product: DP105C/4 manufactured by Doug Mockett and Company.
 - 2. Finish: Matte Chrome.
 - 3. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- F. Drawer Slides:
 - Type: Full extension.
 - 2. Static Load Capacity: Commercial grade for standard drawers and extra-heavy duty for file drawers.
 - Products:
 - Accuride International, Inc: Product 2632 for standard drawers and 4032 for file drawers. www.accuride.com.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- G. Hinges: European style concealed self-closing type.

- 1. Products:
 - a. Hafele; Product 329.17.507 w/ 329.32.500 cover plate
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- H. Fixed Specialty Workstation and Countertop Brackets:
 - 1. Material: Steel.
 - 2. Finish: Manufacturer's standard, factory-applied powder coat.
 - Color: Selected by Architect from manufacturer's standard range.
 - Manufacturers:
 - a. A&M Hardware, Inc; Heavy-Duty Hybrid Brackets: http://www.aandmhardware.com/#sle.
 - o. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.06 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern or at Architect's option, provide solid plastic edge in comparable color.
- D. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 - 1. Provide center matched panels at each elevation.
- E. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.07 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- C. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 Finishing for Grade specified: Opaque finish.
 - 1. Transparent:
 - a. System 5, Varnish, Conversion.
 - b. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 8316 FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

1.02 REFERENCE STANDARDS

- A. ASTM D5319 Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2012.
- B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 6 inches by 6 inches inch in size illustrating material and surface design of panels.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Basis of Design: Marlite; www.marlite.com.
 - Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 PANEL SYSTEMS

- A. Wall Panels: Standard FRP S 100 S/2/S White
 - 1. Panel Size: 4 by 8 feet (1.2 by 2.4 m).
 - 2. Panel Thickness: 0.10 inch (2.5 mm).
 - 3. Surface Design: Smooth.
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
- B. Adhesive: Type recommended by panel manufacturer.
- C. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- G. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 1400 FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
 - 1. Cold-applied modified-polymer elastomeric waterproofing.
- B. Drainage Boards

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

1.03 REFERENCE STANDARDS

- A. ASTM C661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM D1621 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2010.
- C. ASTM D2370 Standard Test Method for Tensile Properties of Organic Coatings; 1998 (Reapproved 2010).
- D. ASTM D6506/D6506M Standard Specification for Asphalt Based Protection Board for Below-Grade Waterproofing; 2001, with Editorial Revision (2018).
- E. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. NRCA (WM) The NRCA Waterproofing Manual; 2005.
- G. NRCA ML104 The NRCA Roofing and Waterproofing Manual; National Roofing ContractorsAssociation; Fifth Edition, with interim updates.

1.04 SUBMITTALS

- A. See TPWD UGC/Special Conditions, for submittal procedures
- B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 10 years documented experience.
- Installer Qualifications: Company specializing in installation of fluid-applied waterproofing approved by manufacturer.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.
- B. Do not apply membrane if rain is forecasted or imminent within 12 hours.

1.07 WARRANTY

A. See TPWD UGC/SPecial Conditions, for additional warranty requirements.

- B. Contractor shall correct defective Work within a ten year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.
- C. Provide ten year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cold-Applied Modified-Polymer Elastomeric Waterproofing:
 - 1. Carlisle Coatings & Waterproofing, Inc; ____: www.carlisleccw.com/#sle.
 - 2. Henry Company; ____: www.henry.com/#sle.
 - 3. W.R. Meadows, Inc; MEL-Rol LM: www.wrmeadows.com/#sle.
 - 4. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 WATERPROOFING APPLICATIONS

- A. Cold-Applied Modified-Polymer Elastomeric Waterproofing:
 - 1. Location: Basement walls.
 - 2. Cover with protection board.

2.03 FLUID APPLIED WATERPROOFING MATERIALS

- A. Primer: Type recommended by membrane manufacturer.
- B. Cold-Applied Modified-Polymer Elastomeric Waterproofing:
 - 1. Cured Thickness: 55 mils, 0.055 inch (1.397 mm), minimum.
 - 2. Suitable for installation over concrete substrates.
 - 3. Tensile Strength: 95 psi (0.655 MPa), measured in accordance with ASTM D2370.
 - 4. Ultimate Elongation: 575 percent, measured in accordance with ASTM D412.
 - Hardness: 55, minimum, measured in accordance with ASTM C661, using Type 00 durometer.
 - 6. Water Vapor Permeability: 0.07 perm inch (4.0 ng/(Pa s sq m)), maximum measured in accordance with ASTM E96/E96M.
 - 7. Manufacturers:
 - a. Carlisle Coatings & Waterproofing, Inc; _____: www.carlisleccw.com/#sle.
 - b. Henry Company; ____: www.henry.com/#sle.
 - c. W.R. Meadows, Inc; MRL-ROL LM: www.wrmeadows.com/#sle.
 - d. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.04 ACCESSORIES

- A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.
- B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
 - Multi-layer internally-reinforced asphaltic panels, 1/8 inch (3 mm) thick, nominal, complying with ASTM D6506/D6506M.
 - Manufacturers:
 - a. W.R. Medows: Protection Course.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
 - 1. Composition: Dimpled polyethylene core; polypropylene or polyester filter fabric.
 - 2. Thickness: 1/4 inch (6.4 mm), minimum.
 - Core Compressive Strength: 15,000 psf (0.72 MPa), minimum, in accordance with ASTM D1621
 - 4. Manufacturers:
 - a. W.R. Meadows; MEL-DRAIN.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Condition of Surface: New concrete surfaces shall be wood float finish ACI301-11.7.3 free of membrane forming curing compounds.
- D. Patch all holes and voids and smooth out any surface misalignments.
- E. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

3.03 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches (150 mm) above horizontal surface for first ply and six inches (____ mm) at subsequent plies laid in shingle fashion.
- D. Install flexible flashings and seals: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- E. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to ensure clamp ring seal, and coordinate with drain installation requirements specified in Division 15 Sections.
- F. Seal membrane and flashings to adjoining surfaces.
 - 1. Install termination bar along edges.
 - Install counterflashing over exposed edges.

3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.

3.05 FIELD QUALITY CONTROL

A. Owner will provide testing services in accordance with TPWD/UGC Special Conditions. Contractor shall provide temporary construction and materials for testing.

3.06 PROTECTION

- A. Protect membrane with application of waterproofing protection course, drainage board, or other approved material.
- B. Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION

SECTION 07 2100 THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, over roof deck, over roof sheathing, and exterior wall behind wall finish.
- B. Batt insulation in exterior wall and roof construction.
- Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

- A. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- B. ASTM C1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016.
- E. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation Inside Masonry Cavity Walls: Polyisocyanurate board.
- B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
- C. Insulation Over Roof Deck: Polyisocyanurate board.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:
 - Class 2 Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 2 20 psi (138 kPa), minimum.
 - 3) Thickness: As noted on drawings
 - 4) Manufactures
 - (a) Hunter Panels, LLC; XCI CG (class A)
 - (b) Atlas Roof Insulation.
 - (c) Substitutions: Refer to Owner's General Conditions and Special Conditions.
 - b. Type V: Faced with oriented strand board (OSB) or plywood on one major surface of core foam and glass fiber reinforced cellulosic felt or uncoated or coated polymer-bonded glass fiber mat facer on other major surface of core foam.
 - 1) Top Lyer Material: 7/16" (11mm) oriented strand board (OSB)
 - 2) Thermal Resistance: R-value of 25
 - 3) Compressive Strength: 16 psi (110 kPa), minimum.
 - 4) Board Edges: Square
 - 5) Manufactures
 - (a) Hunter Panels, LLC; H-Shield NB

- (b) Atlas Roof Insulation
- (c) Substitutions: Refer to Owner's General Conditions and Special Conditions.
- 2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).

2.03 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Thermal Resistance: R-value (RSI-value) of 13 (____).
 - 6. Facing: Unfaced.
 - 7. Manufacturers:
 - a. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - b. Johns Manville; : www.jm.com/#sle.
 - c. Owens Corning Corporation; ____: www.ocbuildingspec.com/#sle.
 - d. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.04 ACCESSORIES

- Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches (406 mm) on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches (102 mm) wide sealant tape; comply with ASTM E2357.
- B. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

- A. Secure impale fasteners to substrate at following frequency:
 - 1. Six (6) per insulation board.
- B. Install boards to fit snugly between wall ties.
- C. Install boards horizontally on walls.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.05 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2500 WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, joints around frames of openings in exterior walls, and . .

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry
- B. Section 04 4313 Stone Masonry Veneer
- C. Section 07 6200 Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 9200 Joint Sealants: Sealing building expansion joints.
- E. Section 09 2116 Gypsum Board Assemblies: Water-resistive barrier under exterior cladding.

1.03 REFERENCE STANDARDS

- A. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- B. ASTM D1970/D1970M Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E2178 Standard Test Method for Air Permeance of Building Materials; 2013.
- E. ICC-ES AC212 Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc; 2015.

1.04 SUBMITTALS

- A. See TPWD UGC/Special Conditions, for submittal procedures
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- E. Manufacturer's Installation Instructions: Indicate preparation.
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification; keep copies of each contractor accreditation and installer certification on site during and after installation, and present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
- B. Perform work in accordance with the printed requirements of the air barrier manufacturer and this specification

- C. Maintain one copy of the manufacturer instructions on site.
- D. Ath the beginning of the work and at all times during the execution of the work, allow access to work site by the air barrier membrane manufacturer's representative.
- E. components used in this section shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, tapes and adhesives as listed as an evaluated air barrier assembly by the air Barrier Association of America.

1.06 MOCK-UP

- A. Provide mock-up of air barrier material as part of exterior wall material mock-up required in other sections.
- B. Items to be incorporated in mock-up include:
 - 1. Where directed by architect, construct typical exterior wall panel incorporating veneer system, through wall flashing, CMU, wall ties, board insulation, aluminum window frame, showing air barrier membrane application details and transition membranes.
- C. Allow fo rinspection of mock-up by architect before proceeding with air barrier work.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
 - 1. Air Barrier Membrane:
 - a. Material: Water-based polymer-modified bitumen.
 - b. Dry Film Thickness (DFT): 30 mil, 0.030 inch (0.762 mm), minimum.
 - c. Air Permeance: 0.004 cfm/sq ft (0.02 L/(s sq m)), maximum, when tested in accordance with ASTM E2178.
 - d. Water Vapor Permeance: 5 perms (287 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F (23 degrees C).
 - e. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to three months of weather exposure.
 - f. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 - g. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - h. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
 - i. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
 - Primer, Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 - k. Manufacturers:
 - Tremco Commercial Sealants & Waterproofing; ExoAir 220: www.tremcosealants.com/#sle.
 - 2) W.R. Meadows, Inc: Air-Shield LMP: www.wrmeadows.com/#sle.
 - 3) Grace construction Products, perm-a-barrier VP, a non-asphaltic product
 - 4) STS Coatings, Wall Guardian; FW-100A, a non-asphaltic product (Basis of design)
 - 5) Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.03 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Coatings:

- 1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
- 2. Prepare CMU surfaces in a manner recommended by coating manufacturer; path cracks, protrusions, small voids, offsets, details, irregularities, and small deformities.
- 3. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.
- 4. Use transition flashing to seal to adjacent construction and to bridge joints.

D. Openings and Penetrations in Exterior Weather Barriers:

- Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
- 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
- 3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
- 4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
- 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
- 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 SCHEDULE

- A. Install liquid membrane system over the entire surface of the sheathing, C.M.U.
 - 1. Seal all masonry anchor penetrtations air tight
- B. Hollow metal door and frames: Seal door frame to wall surface with transition membrane
- C. Wall and roof junction: Seal wall to roof with transition membrane
- D. Seal the top of sheathing, C.M.U to underside of the roof system or structure with foam or sealant
- E. Openings: Seal around the perimeter of all opening with transition membrane.
- F. Perimeter wood nailers at wall openings: Cover all exposed surfaces of wood nailers with transition membrane. Extend membrane over sheathing, masonry and wood framing.
- G. Aluminum window frames with flashing flanges: Seal the flashing flanges to the wall surface with transition membrane.
- H. Aluminum window frames without flashing flanges: Seal frames to the wall surface with transition membrane.
- Aluminum storefront frames: Seal frames to the wall surface with transition membrane.

J. Aluminum curtain wall frames: Seal frames to wall surface with transition membrane.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

SECTION 07 4646 FIBER-CEMENT SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiber-cement siding.

1.02 RELATED REQUIREMENTS

- A. Section 07 2500 Weather Barriers: Weather barrier under siding.
- B. Section 07 9200 Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

- ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM C1186 Standard Specification for Flat Fiber Cement Sheets; 2008 (Reapproved 2012).

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods, including nail patterns.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, _____, and methods of anchorage.
- D. Installer's Qualification Statement.
- E. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
- F. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products under waterproof cover and elevated above grade, on a flat surface.

1.07 WARRANTY

- A. Refer to Owner's General Conditions and Special Conditions, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Provide multi-year manufacturer warranty as indicated under Siding article sub-heading "Warranty".

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

- A. Panel Siding: Vertically oriented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
 - 1. Physical Charasteristics: ASTM C1185, Type A Grade II
 - a. Density Dry: 1405 kg/m3.
 - b. Bending strength at with grain: 36.0 MPa
 - c. Bending strength at across grain: 24.5 MPa.

- d. Modulus of elasticity at with grain: greater than 14.7 GPa.
- e. Modulus of elasticity at across grain: greater than 12.6 GPa
- 2. Texture: Patina.
- 3. Length (Height): 96 inches (2400 mm), nominal.
- 4. Width: 48 inches (1220 mm).
- 5. Thickness: 5/16 inch (8 mm), nominal.
- 6. Finish: Through-colored, muted, matte finish with weather-proof treatment which makes it resistant to staining and surface dirt.
- 7. Color: As selected by Architect from manufacturers full range of available colors.
- 8. Warranty: 10 year limited; transferable.
- 9. Manufacturers:
 - a. AFC Cladding Panels by American Fiber Cement Corp.; Cambrit Patina.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 ACCESSORIES

- A. Cladding Support Clips: Thermally-broken, galvanized steel clips for support of cladding z-girts, angles, channels and other framing.
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.
 - 2. Manufacturers:
 - a. Northern Facades; ISO Clip: www.northernfacades.com/#sle.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- B. Furring Strips: Galvanized metal channels 16 ga.
- C. Fiber-Cement Siding Metal Trim: Extruded aluminum alloy 6063-T5 temper.
 - 1. Dimension and Layout: As indicated on drawings.
 - 2. Finish: Color anodized.
 - 3. Color: Match Panels.
- D. Fasteners: Rivits, color-matched stianless-steel rivits, from panel manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that weather barrier has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
 - Read warranty and comply with terms necessary to maintain warranty coverage.
 - 2. Use trim details indicated on drawings.
 - 3. Touch up field cut edges before installing.
 - 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Masonry Walls: Install furring strips of adequate thickness to accept full length of rivits and spaced at 16 inches (406 mm) on center; leave space at top and bottom open; top may be behind soffit; at bottom install insect screen over opening by wrapping a strip of screen over bottom ends of vertical furring strips.
- C. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- D. Do not install siding less than 6 inches (150 mm) from surface of ground nor closer than 1 inch (25 mm) to roofs, patios, porches, and other surfaces where water may collect.

3.03 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

SECTION 07 6100 SHEET METAL ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet metal roofing, associated flashings, and underlayment.
- B. Standing-seam roofing, trim and attached devices

1.02 RELATED REQUIREMENTS

- A. Refer to Owner's General Conditions and Special Conditions.
- B. Section 06 1000 Rough Carpentry
- C. Section 07 2100 Thermal Insulation
- D. Section 07 6200 Sheet Metal Flashing and Trim: Flashing and other trim
- E. Section 07 9005 Joint Sealers: Field Applied panel sealants

1.03 REFERENCE STANDARDS

- A. UL 580 Standard for Tests for Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.; 1994
- B. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction; 2012.
- D. ASTM D1970/D1970M Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- E. CDA A4050 Copper in Architecture Handbook; current edition.
- F. SMACNA (ASMM) Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Submit metal manufacturer's and fabricator's specifications, installation instructions, and general recommendations for roofing applications.
- C. Shop Drawings: Show manner of forming, joining, and securing sheet metal roofing, and pattern of seams. Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details. Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations. Show layout, jointing, cleat gauges and spacings, profiles, metal gages, support, relationship to adjoining work and other pertinent details.
 - 1. Produce plans and layouts at 1/4 inch scale, details at 3 inch scale.
- D. Installation Samples: Submit two samples 12 x12 inch in size illustrating metal roofing mounted on plywood backing illustrating typical seam, external corner, and internal corner.
- E. Warranty: Submit specified manufacturer's warranty

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise noted.
- B. Installer Qualifications: Company specializing in performing sheet metal roof installations with minimum 10 years of experience.
- C. Wind Uplift: Provide roof assemblies equivalent to the requirements of UL 580 for class 90 wind uplift resistance.

1.06 MOCK-UP

- A. Before proceeding with final purchase of materials and fabrication of sheet metal roofing components, prepare mock-ups as follows:
 - 1. Ridge showing three seams and three sloping planes:
 - 2. Eave detail showing three seams, edge, apron, one sloping plane, and gutter.
 - 3. End detail showing crimped edge connection and fascia.
- B. Locate Mock-ups where directed.
 - 1. Use materials and methods of fabrication and installation identical with project requirements
 - 2. Retain existing mock-up as a quality standard for acceptance of completed sheet metal roofing.
- C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage. Place protective layer between sheets to prevent scratching or damage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.08 WARRANTY

- A. Refer to Owner's General Conditions and Special Conditions, for additional warranty requirements.
- B. Installer Warranty: Correct defective work within a two year period after Date of Substantial Completion. Defective work includes failure of watertightness or seals.
- C. Provide 20 year manufacturer warranty after the date of substantial completion for roof panels, roof flashings, roof penetrations and roof curbs. Warranty shall include degradation of metal finish and failure of watertightness or seals.
- D. Warranty Notification signs
 - 1. Warranty Notification Signs Upon completion of the job, warranty notification signs shall be located at or near all roof entry points and to be coordinated in field with the Texas Parks and Wildlife construction manager. There shall be a minimum of one warranty notification sign for each building or discreet, separate roof area, roof level, or roof section separated by expansion joints.
 - 2. Appearance The sign shall be constructed of 24 gauge metal, at least 18 inches by 24 inches in size and shall be painted professionally be a person or firm experienced in the trade. Painting procedures shall be in accordance with the industry practice for priming, number of coats, and type of paint normally used for work of this type.
 - Attachment Such signs shall be firmly affixed in accordance with standard roofing practice as defined by NRCA details and in such a manner as not to jeopardize the waterproofing integrity of the roofing, flashing, or waterproofing system.
 - 4. The signs shall present the information shown herein.

DO NOT MAKE ALTERATIONS OR REPAIRS TO THIS ROOF WITHOUT APPROVAL FROM OWNER

This roof is under warranty until
(date)
Warranty Number ____
by (Contractor's name
Manufacturer name,
address,
city, state, zip code
and phone number)

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Fine Metal Roof Tech
 - 1. Quadro Roofing Panels (Roof Types 1 and 2)
 - 2. Standing Seam Metal Roofing Panel (Roof Type 3)
- B. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 SHEET MATERIALS

- A. Refer to drawings of roof type and location.
- B. Copper Sheet: ASTM B370, cold rolled, 16 oz/sf, 24 gage, 0.0216 inch (0.55 mm) minimum thickness; manufacturer's standard natural finish.
 - 1. Shingle Roof:Factory formed (Roof Types 1 and 2)
 - a. Panel size: 32 inch wide x 11-3/8 inch high, visible after installation
 - b. Texture: Smooth
 - 2. Standing Seam Roof: Factory formed (Roof Type 3)
 - a. Profile: Double lock standing seam, with minimum 1inch seam height, concealed fastener system for field seaming with special tool
 - b. Texture: Smooth
 - c. Length: Full length of roof slope, without lapping horizontal joints
 - d. Width: Maximum panel coverage of 16 inches.

2.03 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 ACCESSORIES

- A. Miscellaneous Sheet Metal Items; Provide flashing, trim, closure strips, and caps of the same material, thickness, and finish as used for the roofing panels.
- B. Underlayment: self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mils total thickness; with strippable release film and woven polypropylene sheet top surface.
 - Self sealability: passing nail sealability test specified in ASTM D1970/D1970M

- 2. Functional Temperature Range: minus 70 degrees F to 260 degrees F.
- Products
 - a. Grace construction Products; Ultra Ice and Water Shield HT
 - b. Carlisle Coatings and Waterproofing; CCW WIP 300HT
 - Substitutions: Refer to Owner's General Conditions and Special Conditions.
- C. Sealant to be Concealed in Completed Work: type Neutral curing silicone sealant as recommended by manufacturer for substrates to be sealed.
- D. Thermal insulation: Nailboard type; comply with ASTM C 1289, Type V, Closed-cell polyisocyanurate foam board bonded to 7/16 inch oriented strand board (OSB) on one side and universal fiberglass-reinforced facer on opposite side.

2.05 FABRICATION

- A. Fabricate panels and accessory items at the factory, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- B. Form sections true to shape, accurate in size, square, and free from distortion or defects.

2.06 FINISHES

A. Color: As selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to eaves.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.
- C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Clean surface to receive roofing. Substrate to be smooth and free of defects. Drive all projecting nails and fasteners flush with substrate.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations and other adjoining work to assure that the completed roof will be free of leaks.
- C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roofing manufacturer.
- D. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION - ROOFING

- A. Overall: install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use or torches for field cutting is absolutely prohibited.
- B. Accessories: install all components required for a complete roofing assembly, including flashings, rain handler system, trim, moldings, closure strips, preformed crickets, caps, ridge closures, and similar roof accessory items.
- C. Apply underlayment over entire roof area.
- D. Roof panels: Install panels in strict accordance with manufacture's instructions, minimizing transverse joints except at junction with penetrations.

- 1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seam device approved by the panel manufacturer.
- E. Insulation: Install insulation on wood deck in accordance with manufacturer's instructions.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil fils, excess joint sealer, handling marks, and debris from installation, leave the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit traffic or storage of materials over unprotected roof surface.

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and other items indicated in Schedule.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 Unit Masonry: Metal flashings embedded in masonry.
- B. Section 07 6100 Sheet Metal Roofing.
- C. Section 07 9005 Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

- ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. ASTM B32 Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- D. ASTM B749 Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2014.
- E. ASTM D4586/D4586M Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- F. CDA A4050 Copper in Architecture Handbook; current edition.
- G. SMACNA (ASMM) Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- Fabricator and Installer Qualifications: Company specializing in sheet metal work with ______
 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: ArcelorMittal Galvalume Plus
- B. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 SHEET MATERIALS

A. Pre-Finished Galvanized Steel (Galvalume): ASTM A653/653M, with 55% Aluminum-Zinc alloy coating; minimum 24 gage (0.0239 inch) (0.61 mm) thick base metal, with factory coating for unpainted applications.

2.03 ACCESSORIES

- A. Fasteners: Stainless steel, with soft neoprene washers.
- B. Sealant to be Concealed in Completed Work: neutral
- C. Plastic Cement: ASTM D4586, Type I.

2.04 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, minimum 2 inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
- G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.02 INSTALLATION

- Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Slope gutters 1/4 inch per 10 feet (2.1 mm per m), minimum.

SECTION 07 9005 JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

1.02 RELATED SECTIONS

- A. Section 06 2000 Finish Carpentry
- B. Section 08 1213 Hollow Metal Doors and Frames
- C. Section 08 4100 Metal-Framed Storefronts.
- D. Section 08 5113 Aluminum Windows
- E. Section 08 8000 Glazing: Glazing sealants and accessories.
- F. Section 09 3000 Tiling: Sealant used as tile grout.
- G. Section 09 9000 Paints and Coatings

1.03 REFERENCE

- A. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- B. ASTM C1193 Standard Guide for Use of Joint Sealants: 2013.
- C. ASTM D1667 Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).
- D. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition.

1.04 PERFORMANCE REQUIREMENTS

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.06 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, substrate preparation, and color availability. Include material safety data sheets and certifications showing compliance with specified standards.
- C. Samples: Submit two samples, 1/2 x 4 inch in size, illustrating sealant colors for selection.
- D. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primer and substrate preparation needed to obtain adhesion.
- E. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates
 - Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
 - 2. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- F. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.

1.07 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Deliver products in manufacturer's original containers clearly labeled with product identification, date of manufacture, and shelf life.
- C. Store materials in a clean, dry area.
- D. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:
 - 1. Locate test joints on mock-ups specified in reference sections and as directed by Architect.
 - 2. Notify Architect one week in advance of the dates and times when mock-ups will be erected and field adhesion test performed.
 - Arrange for tests to take place with joint sealant manufacturer's technical representative present.
- E. Test Method: Test joint sealants by hand pull method described below.
 - Install joint sealants in 5-feet joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed Work. Allow sealants to cure fully before testing.
 - 2. Make knife cuts horizontally from one side of joint to the other followed by 2 vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2-inch cuts. Place a mark 1 inch from top of 2-inch piece
 - 3. Use fingers to grasp 2-inch piece of sealant just above 1-inch mark; pull firmly down at 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 1 seconds.
- F. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- G. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.08 MOCK-UP

- A. Construct mock-up with specified sealant types and with other components noted.
- B. Locate where directed.
- C. Accepted mock-up may remain as part of the Work.

1.09 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- B. Do not install sealants during inclement weather, strong winds, or when such conditions are expected. All wet surfaces must be dry and frost free.
- C. Optimum sealant application temperature: Between 50 90 degrees F.

1.10 COORDINATION

A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

- A. Refer to Owner's General Conditions and Special Conditions, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers that may have products that meet the specification requirements include:
 - 1. Dow Corning Corp. www.dowcorning.com
 - 2. Tremco. www.tremcosealants.com
 - 3. Sonneborn. www.sonneborn.com
 - 4. General Electric Co. www.geplastics.com
 - 5. United States Gypsum Company. www.usg.com

2.02 SEALANTS

- A. Type-1: Exterior General Silicone Sealant, ASTM C920. Grade NS, Class 25
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Product: 795 Manufactured by Dow Corning.
 - 3. Movement Capability: Plus and minus 25 percent.
 - 4. Service temperature range: -65 to 180 degrees F (-54 to 82 degrees C).
 - 5. Applications: Use for:
 - a. Sealant between window/door casing and exterior wall. Confirm compatibility with water/air barrier.
 - b. Other exterior joints for which no other type of sealant is indicated.
- B. Type-2: General Purpose Interior Sealant: Acrylic-Emulsion Latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Provide manufacturer's standard one-part, non-sag, mildew-resistant, paintable latex sealant that is recommended for exposed applications on interior and protected exterior locations and that accommodates joint width existing at time of installation without failing either adhesively or cohesively. Provide product complying with ASTMC834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints
 - b. Interior joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
 - 3. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - a. "AC-20," Pecora Corp.
 - b. "Sonolac," Sonneborn Building Products Div., ChemRex, Inc
 - c. "Tremflex Acrylic Latex 834," Tremco, Inc
- C. Type-3: Bathtub / Tile Sealant: White Silicone; ASTM C920, Use I, M and A; single component, mildew resistant.
 - 1. Product: 786 manufactured by Dow Corning.
 - 2. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surface.
 - b. Joints between kitchen and bath countertops and wall surface.
- D. Type-4: Nonsag Polyurethane Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A, G, O; single component, chemical curing, non-straining, non bleeding, capable of continous water immersion, non-sagging type.
 - 1. Color: to be selected by architect from manufactirer's standard range.
 - 2. Product: NP1 manufactured by Degussa.
 - 3. Applications:
 - a. Under exterior door thresholds.
- E. Type-5: Self leveling Polyurethane Sealant: ASTM C920, Type S, Grade P. Class 25, Uses T, M, O; single component, chemical curing, non staining, non bleeding, self-leveling type.
 - 1. Color: Color as selected
 - 2. Product: Sonolastic SL 1 manufactured by Sonneborn

- 3. Application: Use for:
 - a. Exterior paving joints
- F. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.03 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.
- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Sheathing Tape:
 - 1. Dow 1,2,3.
 - 2. Quick-Tape; Quick-Tape, Inc.
 - 3. Perma-Tite Tape- PGM 207A; PermaGlass-Mesh, Inc.
- E. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- F. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Ensure surfaces are clean, dry, and free of frost, dust, dirt, grease, oil, curing compounds, form release agents, laitance, efflorescence, mildew, and previous films and coatings.
- C. Verify that joint backing and release tapes are compatible with sealant.
- D. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - 1. Coordinate with Division 4 installers to establish the correct depth and configuration of masonry joints to be pointed with sealant.
- E. Proceed with installation only after satisfactory conditions have been corrected.

3.02 PREPARATION

- A. Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air. Porous joint surfaces include the following:
 - a. Stone
 - b. Brick
 - c. Wood
 - 3. Remove laitance and form-release agents.
- B. Remove loose materials and foreign matter that could impair adhesion of sealant.
- C. Clean and prime joints in accordance with manufacturer's instructions.
 - 1. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine

primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- D. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- E. Protect elements surrounding the work of this section from damage or disfigurement.
 - 1. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 - 1. Width/depth ratio of 2:1.
 - 2. Neck dimension no greater than 1/3 of the joint width.
 - 3. Surface bond area on each side not less than 75 percent of joint width.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tooling for Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Tool joints concave and slightly recessed at edges for vertical joints.
 - 2. Tool joints flush and slightly recessed at edges for paving and floor joint sealants.
- Provide color break of sealant on vertical expansion joints as required to match adjacent stone color.
- I. Provide appropriate curing and installation of sealants to prevent color bleeding.
- J. Provide joint configuration per shield manufacturer's literature and details on drawings for recess depth and sealant overlap at locations indicated to receive lead 'tee' shield.
 - 1. Use masking tape to protect adjacent surfaces of capped joints. Form shield by notching back flange at 3-4" intervals to tightly follow masonry surface contour.

3.04 FIELD QUALITY CONTROL

- A. When directed by Architect, perform field-adhesion tests in locations and numbers required. Cost of tests will be paid by Contractor for first 10 tests. Additional tests will be paid:
 - 1. by Contractor if sealant fails test, or
 - 2. by Owner if sealant passes test.
- B. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
 - Test Method: Test joint sealants by hand-pull method described below:
 - a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 2-inch (50-mm) piece
 - b. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds

- c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side
- 2. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
- 3. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria
 - b. Whether sealants filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
- 4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions
- 5. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- C. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements

3.05 CLEANING

- A. Remove masking tape and excess sealant.
- B. Clean adjacent soiled surfaces.

3.06 PROTECTION

Protect sealants until cured.

SECTION 08 1213

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Thermally insulated steel doors.
- C. Steel glazing frames.
- D. Accessories, including louvers.

1.02 RELATED REQUIREMENTS

- A. Section 07 9005 Joint Sealers.
- B. Section 08 7110 Door Hardware.
- C. Section 08 8000 Glazing: Glass for doors and borrowed lites.
- D. Section 09 9000 Paints & Coatings: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.8 Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- C. ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- D. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- E. ASTM C1363 Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2011.
- F. BHMA A156.115 American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014. (ANSI/BHMA A156.115)
- G. ICC A117.1 Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).
- H. NAAMM HMMA 840 Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE

A. Maintain at the project site a copy of all reference standards dealing with installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.

- 2. Republic Doors; Product DE Series: www.republicdoor.com.
- 3. Steelcraft, an Allegion brand: www.allegion.com/us.
- 4. Substitutions: See Owner's General Conditions and Special Conditions.

2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Door Top Closures: Flush with top of faces and edges.
 - 3. Door Edge Profile: Beveled on both edges.
 - 4. Door Texture: Smooth faces.
 - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 - 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 7. Galvanizing for exterior units: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness
 - 8. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

- A. Exterior Doors: Non-Fire-Rated
 - Grade: ANSI/SDI A250.8 (SDI-100); Level 3 Extra Heavy-Duty, Physical Performance Level A, Model 1 - Full Flush.
 - 2. Core: Polyurethane.
 - 3. Thickness: 1-3/4 inch (44.5 mm).
 - 4. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 5. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
 - 6. Weatherstripping: Separate, see Section 08 7100.

2.04 STEEL FRAMES

- A. General:
 - 1. Comply with the requirements of grade specified for corresponding door.
 - 2. Finish: Factory primed, for field finishing.
 - Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 - 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (100 mm) high to fill opening without cutting masonry units.
- B. Exterior Door Frames: Fully welded.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 2. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire-Rated: Slip-on drywall type, with knockdown type at masonry walls.
- D. Interior Door Frames, Fire-Rated: Slip-on drywall type, with knockdown type at masonry walls.
 - 1. Fire Rating: Same as door, labeled.
- E. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 ACCESSORY MATERIALS

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 - 1. Style: Sightproof inverted V blade with bug screen.
 - 2. Product: Titus T-700L.
- B. Glazing: As specified in Section 08 8000, factory installed.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.
- F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.06 FABRICATION

- A. Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick, metallic-coated, inverted steel channels with channel webs placed even with top and bottom edges.
- C. Interior Door Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
 - 1. Cold-rolled steel sheet.
- D. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.
- E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.
- F. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- G. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- H. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier.
 - 1. In addition to typical door and frame hardware, coordinate and factory prepare doors and frames as required for security devices and all other building systems devices.
 - 2. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
 - 3. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.
- J. Frame Construction: Fabricate frames to shape shown.
 - 1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints, unless otherwise indicated.
 - 2. Provide welded frames with temporary spreader bars.

- K. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- L. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.07 FINISH MATERIALS

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Place frames before construction of enclosing walls and ceilings.
 - For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
- D. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: As indicated in ANSI/SDI A250.8 (SDI-100).
- B. Maximum Diagonal Distortion: 1/16 in (1.5 mm) measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

SECTION 08 1416 FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 1213 Hollow Metal Frames.
- B. Section 08 7100 Door Hardware.
- C. Section 08 8000 Glazing.
- D. Section 09 9123 Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2016.
- B. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- C. WDMA I.S. 1A Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. Comply with Owner's General Conditions and Special Conditions.
- Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 6 by 6 inches (___ by ___ mm) in size illustrating wood grain, stain color, and sheen.
- E. Specimen warranty.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Specimen warranty.
- H. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Owner's General Conditions and Special Conditions for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Haley Brothers; ____: www.haleybros.com/#sle.
 - 2. Oregon Door; Architectural Series: www.oregondoor.com/#sle.
 - 3. VT Industries, Inc; : www.vtindustries.com/#sle.
 - 4. Substitutions: See Owner's General Conditions and Special Conditions

2.02 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - B. Wood veneer facing for field opaque finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.06 ACCESSORIES

- A. Glazing: See Section 08 8000.
- B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- C. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

SECTION 08 3100 ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating; Field Paint Finish

1.03 REFERENCE STANDARDS

A. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Comply with Owner's General Conditions and Special Conditions.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units with Return Air Grille, Unless otherwise indicated:
 - 1. Panel Material: Steel.
 - 2. Size: 12 by 12 inches (305 by 305 mm), Unless otherwise indicated.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
 - 5. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- B. Wall-Mounted Units in Wet Areas:
 - Panel Material: Stainless steel, Type 304.
 - 2. Size: 12 by 12 inches (305 by 305 mm), Unless otherwise indicated.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
 - 5. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- C. Ceiling-Mounted Units with Return Air Grille:
 - 1. Panel Material: Steel.
 - 2. Size Lay-In Grid Ceilings: To match module of ceiling grid.
 - 3. Size Other Ceilings: 18 by 18 inches (___ by ___ mm), Unless otherwise indicated.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL AND CEILING MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. ACUDOR Products Inc: www.acudor.com/#sle.
 - 2. Karp Associates, Inc; ____: www.karpinc.com/#sle.
 - 3. Larsen's Manufacturing Company
 - 4. Milcor, Inc; ____: www.milcorinc.com/#sle.
 - 5. Substitutions see Owner's General Conditions and Special Conditions
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Door Style: Single thickness with rolled or turned in edges.

- 2. Frames: 16 gage, 0.0598 inch (1.52 mm), minimum thickness.
- 3. Heavy Duty Single Steel Sheet Door Panels: 14 gage, 0.0747 inch (1.89 mm), minimum thickness.
- 4. Primed: Polyester powder coat; color _____
- 5. Door/Panel Size: As indicated on the drawings.
- 6. Hardware:
 - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - b. Latch/Lock: Tamperproof tool-operated cam latch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

SECTION 08 3616 BARN (SLIDING) DOOR

PART 1 GENERAL

1.01 SUMMARY

A. Wood doors, barn (sliding) type, Steel and related hardware.

1.02 RELATED SECTION

A. Section 08 7100 - Door Hardware

1.03 SUBMITTALS

- A. Comply with Owner's General Conditions and Special Conditions.
- B. Product Data: Submit manufacturer's product data, including installation instructions
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show blocking by others.
- D. Samples: Submit manufacturer's samples of the following sliding door components:
 - 1. Sample of door construction including specified finish
 - 2. Sample of track metal including specified finish
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Warranty Documentation: Submit manufacturer's standard warranty.

1.04 QUALITY ASSURANCE

- A. Product Options: drawings indicate size, profiles, and dimensional requirements of interior frames and doors.
- B. Source: Obtain sliding barn door hardware form a single source.
- C. Manufacturer's Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of sliding doors similar to that specified. Barn doors should be manufactured in America.

1.05 REFERENCES

- A. ANSI American National Standards Institute
 - 1. ANSI 156.18 Materials and Finishes
 - ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
 - a. BHMA Builders Hardware Manufacturers Association
 - b. DHI Door and Hardware Institute
 - c. NFPA National Fire Protection Association
 - 1) NFPA 80 Fire Doors and Windows
 - 2) NFPA 101 Life Safety code
 - 3) NFPA 105 Smoke and Draft Control Door Assemblies
 - 4) NFPA 252 Fire Tests of Doors Assemblies.

1.06 PERFORMANCE

- A. Flame spread test ASTM E-84.03a. Passed IBC Code 2006 Class A, Class B and Class C.
- B. Soft self-closing mechanism integrated with top track.

1.07 DELIVERY: STORAGE AND PROTECTION

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.

- Keep materials in manufacturer's original, unopened containers and packaging until installation.
- 3. Store materials in clean, dry area indoors.
- 4. Protect materials and finish during storage, handling, and installation to prevent damage.

PART 2 PRODUCTS

2.01 MANUFACTURER

2.02 BASIS OF DESIGN:

- A. RusticaHardware. Website: https://rusticahardware.com/
 - 1. Address: 1520 North Main Street, Springville, UT, 84663

2.03 STEEL BARNDOOR HARDWARE

- A. Door Guide:
 - 1. Basis of Design: RusticaHardware Model: Floor Mount Standard Guide
- B. Door Pull:
 - 1. Basis of Design: RusticaHardware Model: Loft Pull, with barn door hook
 - a. Handle finish: Industrial Bronze
 - b. Door Pull Size: 8 inches
- C. Steel Track and Sliders
 - Basis of Design RusticaHardware Model: Boxtrack
 - a. Track length: Length required
 - b. Track Finish: Industrial Bronze
 - c. Additional hangers as required by manufacturer

2.04 WOOD DOOR

- A. Door:
 - 1. Basis of Design: Rustica Hardware Model: Five Panel Acrylic Barn Door
 - a. Door finish: Painted
 - b. Panel Material: Wood
 - c. Track holes: No holes
 - d. Size as Indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.
- B. Verify dimensions of wall openings.
- C. Examine surfaces to receive top and bottom guide.
- Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.
- E. Do not begin installation until unacceptable conditions are corrected.
- F. Verify installation will not conflict with specified base.

3.02 INSTALLATION

- A. Install sliding doors in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install sliding doors plumb, level, square, and in proper alignment.
- C. Install sliding doors to close against walls without gaps.
- D. Install sliding doors to open and close smoothly.
- E. Anchor sliding doors securely in place to supports. Blocking is required at full width/length of top track.

3.03 ADJUSTING

- A. Adjust sliding doors for proper operation in accordance with manufacturer's instructions.
- B. Adjust sliding doors to operate smoothly without binding.
- C. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

3.04 CLEANING

- A. Clean sliding doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage materials or finish.

3.05 PROTECTION

A. Protect installed sliding doors from damage during construction.

SECTION 08 4100 METAL-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Storefront accessories, including perimeter trims, stools, accessories, shims and anchors.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Exterior door hardware.
- F. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 07 9005 Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08 5113 Aluminum Windows
- C. Section 08 8000 Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- B. AAMA 501.2 Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2009 (part of AAMA 501).
- C. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- D. AAMA 612 Voluntary Specification, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum: 2002.
- E. AAMA 1503 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association: 2009.
- F. AAMA 2603 Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.
- G. AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.
- H. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.
- I. ASCE 7 Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2005.
- J. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- K. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.
- L. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes: 2008.
- M. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2007.
- N. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.

- ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).
- P. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- Q. ASTM E547 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; 2000 (Reapproved 2009).
- R. ASTM E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2000 (Reapproved 2008).

1.04 ADMINISTRATIVE REQUIREMENTS

- Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations. Data should be certified by a Professional Structural Engineer experienced in design of this Work and licensed in Texas.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Samples:

- 1. Submit two samples 12 x 12 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials, joinery, and anchorage.
- 2. Submit samples of standard factory anodized finishes for selection by Architect.
- G. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- H. Report of field testing for water leakage.
- Warranty: Submit manufacturer warranty and ensure forms have been registered with manufacturer.
- J. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at Texas.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.
- C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 PROJECT CONDITIONS

A. Verify actual dimensions of aluminum-framed openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design for Storefront: Kawneer 1600 Wall System 1 Curtain Wall
- B. Basis of Design for Exterior Doors: Kawneer AA 250 Thermal Entrance Door
- C. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Position: Front-Glaze.
 - 2. Vertical Mullion Dimensions: 2 1/2 inches wide x 6 inches deep.
 - 3. Water Leakage Test Pressure Differential: As recommended by manufacturer.
 - 4. Air Infiltration Test Pressure Differential: 1.57 psf.
 - 5. Finish: Anodized.
 - 6. Color: As selected by Architect.

B. Framing System:

- 1. Brackets and Reinforcing: Manufacturer's standard high strength aluminum with non-staining, non-ferrous shims for aligning system components.
- 2. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- 3. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Performance Requirements:

- Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of 2012 IBC.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- 2. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

- Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM F283
- 4. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed.
- 5. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.
- 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- 7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.
- 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Glazing stops: Flush.
 - 2. Cross-Section: As indicated on drawings.
- B. Doors: Glazed aluminum.
 - 1. Thickness: 2-1/4 inches.
 - 2. Top Rail: 2-1/2 inches wide.
 - 3. Vertical Stiles: 2-1/2 inches wide.
 - 4. Bottom Rail: 10 inches wide.
 - 5. Glazing Stops: Beveled.
 - 6. Finish: Same as storefront.
 - 7. Weather strip: Manufacturer's thermoplasic elastomer weatherstrip at jambs, headers, and bottom.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Nonmagnetic Stainless Steel
- D. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- E. Concealed Flashings: 0.018 inch thick galvanized steel.
- F. Perimeter Sealant: As specified in Section 07 9000.
- G. Glass: As specified in Section 08 8000.
 - 1. Glass in Exterior Framing: Insulated Safety Glass.
 - 2. Glass in Doors: Insulated Safety Glass
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating or AAMA 612 electrolytically deposited colored anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.

2.06 HARDWARE

- Door Hardware: Storefront manufacturer's standard type to suit application. Reference Door Hardware Schedule 08 7100.
 - 1. Finish on Hand-Contacted Items: Brushed stainless steel.
 - 2. Include for each door weatherstripping, sill sweep strip, threshold, pivots, and narrow stile handle latch.

2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

- A. Package, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected from exposure to harmful conditions. Handle components to avoid damage. Protect material against damage from the elements, construction activities, and other hazards before, during, and after installation.

3.02 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.03 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- Set thresholds in bed of mastic and secure.

- K. Install hardware using templates provided.
- Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 9000.
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.04 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

3.06 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.07 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.08 PROTECTION

A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 4313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 08 7100 Door Hardware: Hardware items other than specified in this section.
- C. Section 08 8000 Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.2 Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- C. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2012.
- D. ASCE 7 Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- E. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- F. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]: 2014.
- G. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes: 2014.
- H. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- I. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- J. ASTM E330/E330M Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- K. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 WARRANTY

- A. See Owner's General Conditions and Special Conditions, for additional warranty requirements.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer 601T.
- B. [Ticket Window] Type:
 - 1. Basis of design : QuikServ FM-42E
- C. Other Acceptable Aluminum-Framed Storefronts Manufacturers:
 - 1. Tubelite, Inc; ____: www.tubeliteinc.com/#sle.
 - 2. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
 - 2. Glazing Position: Centered (front to back).
 - 3. Vertical Mullion Dimensions: 2 inches wide (by 6 inches deep).
 - 4. Finish: Class II natural anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 5. Finish Color: As selected by Architect from manufacturer's standard line.
 - 6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:

- 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.

- Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf
- Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall 3. area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - Glazing Stops: Flush.
- B. Glazing: As specified in Section 08 8000.
- C. Swing Doors: Glazed aluminum.
 - Thickness: 1-3/4 inches (43 mm). 1.
 - Top Rail: 4 inches (100 mm) wide. 2.
 - 3. Vertical Stiles: 4-1/2 inches (115 mm) wide.
 - 4. Bottom Rail: 10 inches (254 mm) wide.
 - 5. Glazing Stops: Square.
 - Finish: Same as storefront.
- D. Flashing Fin: 1 1/2 x 1 1/2 inch, 18 gage aluminum break metal.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Stainless steel.
- D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- Glazing Accessories: As specified in Section 08 8000. E.

2.05 FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

2.06 HARDWARE

- A. Other Door Hardware: As specified in Section 08 7100.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

- E. Seal over fasteners subject to exposure to moisture with sealant.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- H. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- I. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- J. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- K. Install hardware using templates provided.
 - 1. See Section 08 7100 for hardware installation requirements.
- L. Install glass _____ in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

- A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as directed by Architect.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413

GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.
- Aluminum-framed curtain wall accessories, including perimeter trims, stools, accessories, shims and anchors.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 07 9005 Joint sealers: Perimeter sealant and back-up materials.
- B. Section 08 5113 Aluminum Windows
- C. Section 08 8000 Glazing.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.1 Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure; 2005.
- C. AAMA 501.2 Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- D. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum; 2012.
- E. AAMA 612 Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum: 2015.
- F. AAMA 1503 Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- G. AAMA 2603 Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.
- H. AAMA 2604 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- I. AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- J. ASCE 7 Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- K. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2014.
- L. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- M. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- N. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- O. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- P. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

- Q. ASTM E283/E283M Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- R. ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- S. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- T. ASTM E547 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; 2000 (Reapproved 2009).
- U. ASTM E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
- V. SSPC-Paint 20 Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, door hardware, and infill.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure. Data is required to be certified by a Professional Structural Engineer experienced in design of this Work and licensed in Texas.
- F. Hardware schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

G. Samples:

- 1. Submit two samples 12 x 12 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials, joinery, and anchorage.
- 2. Submit samples of factory anodized aluminum finishes for selection by Architect.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.

- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- C. Source Limitations: Obtain aluminum-framed curtain wall system through one sources from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 PROJECT CONDITIONS

A. Verify actual dimension of aluminum-framed openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Refer to Owner's General Conditions and Special Conditionsfor additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

- A. Storefront: Kawneer 1600 Wall System1 Curtain Wall
- B. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below.
 - 1. Trulite Glass & Aluminum Solutions, LLC; : www.trulite.com/#sle.
- C. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
 - 2. Vertical Mullion Dimensions: 2 1/2 inches wide x 6 inches deep.
 - 3. Finish: Class II natural anodized.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 - 4. Color: As selected by Architect.
 - Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Framing System:

- 1. Brackets and Reinforcing: Manufacturer's standard high strength aluminum with non-staining, non-ferrous shims for aligning system components.
- 2. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- 3. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Performance Requirements:

- Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads equal to 1.5 times the design wind loads and 10 second duration of maximum load:
 - a. Design Wind Loads: Comply with the requirements of 2015 IBC code.
 - b. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
 - c. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
- 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- 3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 - a. Test Pressure Differential: 10 psf (480 Pa).
- 4. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283/E283M at 6.27 psf (300 Pa) pressure differential across assembly.
- 5. Thermal Performance Requirements:
 - Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
- 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- 7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Glazing stops: Flush
 - 2. Cross-Section: As indicated on drawings.
 - 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
 - 4. Glazing: As specified in Section 08 8000.
- B. Doors: Glazed aluminum.
 - 1. Thickness: 1 3/4 inches.
 - 2. Top Rail: 4 inches wide.
 - 3. Vertical Stiles: 4-1/2 inches wide.
 - Bottom Rail: 10 inches wide.

- 5. Glazing stops: square.
- 6. Finish: Same as storefront.
- 7. Weather strip: Manufacturer's thermoplastic elastomer weatherstrip at jambs, headers, and bottom.
- C. Flashing fin: 1 1/2 x 1 1/2 inch, 18 gage aluminum break metal

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
- E. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- F. Concealed Flashings: Galvanized steel, 26 gage, 0.0179 inch (0.45 mm) minimum base metal thickness.
- G. Glass: As specified in Section 08 8000.
 - 1. Glass in Exterior Framing: Insulated Safety Glass.
 - 2. Glass in Doors: Insulated Safety Glass.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- Glazing Accessories: As specified in Section 08 8000.
- J. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES

- A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating or AAMA 612 electrolytically deposited colored anodic coating with electrolytically deposited organic seal; not less than 0.7 mils (0.018 mm) thick.

2.06 HARDWARE

- A. Door Hardware: Curtain wall manufacturer's standard type to suit application. Reference Door Hardware Schedule 08 7100.
 - Include for each door weatherstripping, sill sweep strip, threshold, pivots, and narrow stile handle latch.

2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

- Package, Shipping, Handling and Unloading: Deliver materials in manufacturer's original. unopened, undamaged containers with identification labels intact.
- Storage and Protection: Store materials protected from exposure to harmful conditions. Handle components to avoid damage. Protect material against damage from the elements, construction activities, and other hazards before, during, and after installation.

3.02 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.03 INSTALLATION

- A. Install curtain wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- Set thresholds in bed of mastic and secure.
- Install hardware using templates provided.
- Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 9000.
- Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.04 TOLERANCES

- Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.
- Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.05 FIELD QUALITY CONTROL

Field Tests: Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

- B. Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
 - 1. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, which ever is greater.
 - 2. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).
 - 3. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.06 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.07 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.08 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00 - FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor's base bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractor's base bid. The hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies.
- B. The General Contractor shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor to address any such issue could be considered acceptance of the hardware specified and any and/or all discrepancies could be corrected at the General Contractor's expense.
- C. Items include but are not limited to the following:
 - 1. Hinges Pivots
 - 2. Flush Bolts
 - 3. Exit Devices
 - 4. Locksets and Cylinders
 - 5. Push Plates Pulls
 - 6. Coordinators
 - 7. Closers
 - 8. Kick, Mop and Protection Plates
 - 9. Stops. Wall Bumpers. Overhead Controls
 - 10. Electrified Hold Open Devices
 - 11. Thresholds, Seals and Door Bottoms
 - Silencers
 - 13. Miscellaneous Trim and Accessories
- **1.02 RELATED DOCUMENTS**, drawings and general provisions of contract, including owner's general conditions and special conditions sections, apply to this section.
- **1.03 RELATED WORK** specified elsewhere that should be examined for its effect upon this section:
 - A. Section 06 20 00 Finish Carpentry
 - B. Section 08 12 13 Steel Doors and Frames
 - C. Sections 08 31 13 Access Doors
 - D. Section 08 41 13 Aluminum Entrances, Storefront and Window Framing
 - E. Sections 08 80 00 Glass and Glazing
 - F. Sections 09 91 00 Painting
 - G. Division 26 Electrical
 - H. Division 28 Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80 Standard for Fire Doors and Windows
- B. NFPA-101 Life Safety Code
- C. ADA The Americans with Disabilities Act Title III Public Accommodations
- D. ANSI-A 117.1 American National Standards Institute Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS Uniform Federal Accessibility Standards
- G. UL Underwriter's Laboratories
- H. WHI Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C Positive Pressure
- K. IBC-2018 International Building Code
- L. NFPA-70 International Electrical Code

1.05 SUBMITTALS

- A. HARDWARE SCHEDULES submit copies of schedule in accordance with owner's general conditions and special conditions. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to these specifications as required.
 - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience (minimum fifteen (15) years in the industry) who will be made available at reasonable times to consult with the Architect/Contractor and/or the Owners Representative regarding any matters affecting the finish hardware on this project.

All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a one- (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

- 1. All Closers shall have a thirty- (5) year written warranty.
- 2. All Grade 1 "L9000" Locksets shall have a five- (5) year written warranty.
- 3. All Exit Devices shall have a three (3) year written warranty.
- 4. All Continuous Hinges shall have a ten-(5) year written warranty.

PART 2 - PRODUCTS

2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with wood screws and plastic anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of all fastenings shall harmonize with the hardware as to material and finish.
- D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

The hardware shall ship to the job site is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers lves, Hager, Mc Kinney or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).
- C. Provide all out-swinging doors with non-removable pins or security studs as called for in 3.02 Hardware Sets. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.
- D. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise noted in 3.02 Hardware Sets.
- F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width.
- H. At labeled door's steel or stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.

2.04 LOCK AND LOCK TRIM

- A. All locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locksets specified are Schlage "L9000" series with the 03B levers and shall be provided as specified.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
- Mechanical Locks shall meet ANSI Operational Grade 1, Series 1000 as specified.
 - 1. Hand of lock is to be field reversible or non-handed.
 - 2. All lever trim is to be through-bolted through the door.

2.05 CYLINDERS AND KEYING

A. Provide all exterior and interior locks or Exit Devices requiring cylinders keyed to the New Small Format Interchangeable Core Mater Key System as instructed by

the Owners Representative. Cylinders shall comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. The hardware supplier shall meet with the General Contractor, the Architect and the Owners Representative at the project jobsite to determine all permanent keying requirements.

- B. Cylinders shall be factory keyed and factory maintained as directed by the owners Representative and the Architect. Provide two- (2) keys per cylinder and four- (4) master keys per master used.
- C. Factory stamp all keys "Do not duplicate" and with key symbol as directed by the Owners Representative. Visual key control shall be provided on all permanent keys and cylinders.
- D. Provide temporary keyed construction cores for the duration of the construction phase. Provide ten (10) construction keys and two (2) construction control keys. All construction cores shall be returned to the hardware supplier upon installation of permanent cores.

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with a one-piece removable cover, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets.
- E. Exit Devices shall be the modern push rail design. All exit devices shall be mounted with sex bolts and installed with the manufactures standard screws. Exit Hardware Devices found to be installed with self-drilling and self-tapping screws shall be removed and reinstalled at the installer expenses.
- F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship.
- G. Furnish roller strikes for all rim and surface vertical rod exit devices. Internal springs shall be coil compression type. Furnish security dead latching for all active latch bolts.
- H. All Exit Devices shall be field modifiable as incorporate an Electric Latch Retraction Feature without the purchase of new Panic Exit Hardware.
- J. Exit Devices shall be the Von Duprin "99 & 33A" series as specified or acceptable products manufactured by Precision if proven to be equal.

2.07 SURFACE MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength case iron cylinder to provide control throughout the entire door opening and closing cycle.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and noncritical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.
- E. Provide closer covers only if provided as a standard part of the door closer package.
- F. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacture for a proper and functional installation as part of their base bid.
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
- H. Provide drop plates and any additional mounting brackets required for the proper installation of the door closer shall be included in the hardware supplier's base bid.
- I. Finish: Baked on Powder Coated finish shall match other hardware.
- Provide and mount all door closers with sex bolts as provided by the manufacturer.
- K. Closers shall be LCN "4040XP & 1461 HD/HDPA" series as specified or acceptable products manufactured by Sargent "281" series.

2.08 DOOR STOPS AND HOLDERS

- A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified. The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.
- D. Finish: Shall match other hardware where available.

E. Acceptable Products

1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, ABH and Trimco are acceptable.

2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Hager and Trimco are acceptable.
- B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 1-½ inches or 1 inch less than door width (LDW) as specified. They are to be of 16-gauge thick base metal. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.
- C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- D. Finish: Same as other hardware where available.

2.10 FLUSH BOLTS AND COORDINATORS

A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Hager and Trimco are acceptable. Finish shall match the adjacent hardware.

2.11 THRESHOLDS AND SEALS

- A. Provide materials and finishes as listed in hardware sets. Zero products have been specified to set a high level of quality, equivalent product by manufactured by National Guard Products and Pemko shall be acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with Zero 226 MSLA anchoring application. Supply all necessary anchoring devices as supplied by the product manufacturer for the installation of weather strip and sound seal.
- C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather strip inserts shall be a silicone based product as specified in 3.02 Hardware Sets. Other materials used shall be rejected, unless originally specified.
- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.
- E. Install all Threshold in a full bed of sealant as to prevent water & insect penetration inside of the building.

2.12 FINISHES

A. Finishes for all hardware are as required in this specification and the hardware sets.

B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.13 DOOR SILENCERS

A. Provide door silencers at all openings without gasket. Provide two- (2) each at pair of doors and three- (3) or four- (4) each for each single door (coordinate with the frame manufacturer).

2.14 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the Owners Representative.
- C. Architect and the Owners Representative reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

- A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years of experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.
- B. The hardware supplier's office and/or warehouse shall be located within a one seventy-five (75) mile radius of the project site as to better service the general contractor and the Owners Representative during this project.
- C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- D. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

HARDWARE GROUP NO. 001 - ACCESS CONTROLLED

FOR USE ON MARK/DOOR #(S):

11

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

2	EA	CONT. HINGE	110HD ACCESS PANEL 8 WIRE-DOOR HEIGHT	DB	ABH
1	EA	ELEC EXIT HARDWARE	RX-QEL-3347-EO	643E	VON
1	EΑ	ELEC EXIT HARDWARE	RX-QEL-3347-NL/OP	643E	VON
1	EΑ	SFIC RIM CYLINDER	80-159	643E	SCH
1	EΑ	SFIC EVEREST CORE	80-037	606	SCH
2	EΑ	OFFSET PULL	8190-12"-O/F MOUNTING	643E	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	695	LCN
2	EA	DROP PLATE	4040XP-18PA	695	LCN
2	EA	BRACKETS	4040XP-30	695	LCN
2	EA	DOOR SWEEP	39BK LENGTH AS REQ	BK	ZER
1	EA	THRESHOLD	655BK-226-FRAME WIDTH	BK	ZER
1	EA	SHARED POWER	PS906 X 900-4R X 900-4R X 900-8F	LG	VON
		SUPPLY			
		PERIMETER SEAL	PROVIDED BY DOOR/FRAME MFG		
		MEETING STILE SEAL	PROVIDED BY DOOR/FRAME MFG		
		CARD READER	PROVIDED BY DIVISION 28		
		DOOR CONTACT	PROVIDED BY DIVISION 28		

POWER SUPPLY SPECIFIED SHALL POWER ELECTRIFIED HARDWARE ON DOORS #11, 10A, 16, 18A & 18B AN DMUST BE LOCATED IN A CENTRALIZIED LOCATION TO MINUMIZE WIRE RUN DISTANCES.

HARDWARE GROUP NO. 002

FOR USE ON MARK/DOOR #(S):

23A 23B 3 4

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	643E	IVE
1	EA	STOREROOM LOCK	L9080HD 03B	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	WALL STOP	WS406/407CCV	613	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 003 - FIRE RATED

FOR USE ON MARK/DOOR #(S):

19

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

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	REPLACEMENT HEADQUARTERS PHASE 1	

3	EA	HINGE	5BB1 4.5 X 4.5	643E	IVE
1	EA	CLASSROOM LOCK	L9070HD 03B	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	1461 HD	695	LCN
1	EA	WALL STOP	WS406/407CCV	613	IVE
1	ST	SMOKE SEAL	8145S-BK-PSA-HEAD & JAMBS	BK	ZER

HARDWARE GROUP NO. 004 - ACCESS CONTROLLED

FOR USE ON MARK/DOOR #(S):

16

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

2	EA	HINGE	5BB1 4.5 X 4.5 NRP	643E	IVE
1	EΑ	HINGE	5BB1 4.5 X 4.5 TW8	643E	IVE
1	EA	STOREROOM LOCK	L9092EUHD 03B RX	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	1461 HDPA	695	LCN
1	EA	WALL STOP	WS406/407CCV	613	IVE
3	EA	SILENCER	SR64	GRY	IVE
		CARD READER	PROVIDED BY DIVISION 28		
		DOOR CONTACT	PROVIDED BY DIVISION 28		
		SHARED POWER	REFERENCE HARDWARE SET 001		
		SUPPLY			

HARDWARE GROUP NO. 005 - ACCESS CONTROLLED - FIRE RATED

FOR USE ON MARK/DOOR #(S):

18B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

2	EA	HINGE	5BB1 4.5 X 4.5 NRP	643E	IVE
1	EA	HINGE	5BB1 4.5 X 4.5 TW8	643E	IVE
1	EA	STOREROOM LOCK	L9092EUHD 03B RX	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	1461 HDPA	695	LCN
1	EA	WALL STOP	WS406/407CCV	613	IVE
1	SET	SMOKE SEAL	8145S-BK-PSA-HEAD & JAMBS	BK	ZER
		CARD READER	PROVIDED BY DIVISION 28		
		DOOR CONTACT	PROVIDED BY DIVISION 28		
		SHARED POWER	REFERENCE HARDWARE SET 001		
		SUPPLY			

HARDWARE GROUP NO. 006 - ACCESS CONTROLLED - FIRE RATED

FOR USE ON MARK/DOOR #(S):

18A

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08 7100

TPWD TYLER STATE PARK 08 REPLACEMENT HEADOLIARTERS PHASE 1

		REPL	ACEME	NT HEADQUARTERS P	HASE 1		
PROV	IDE EAG	CH SGL DOOR(S) W	ITH THI	E FOLLOWING:			
1	EA	CONT. HINGE		110HD ACCESS PANE HEIGHT	L 8 WIRE-DOOR	DK/B	ABH
1 1 1 1 1 1 1 1 1	EA EA EA EA SET EA EA EA	PANIC HARDWARI SFIC RIM CYLINDE SFIC EVEREST CO OFFSET PULL SURFACE CLOSES SMOKE SEAL RAIN DRIP HEAD WEATHER S JAMB WEATHER S DOOR SWEEP THRESHOLD DOOR CONTACT	ER DRE R R STRIP STRIP	QEL-RX-99-NL/-F 80-159 80-037 8190-12"-O/F MOUNTI 4040XP SCUSH ST-15 8145S-BK-PSA-HEAD 142A DW + 4" 429S-1 PC HEADER W	95 & JAMBS /IDTH IGHT Q DTH	643E 643E 606 643E 695 BK BK BK BK	VON SCH SCH IVE LCN ZER ZER ZER ZER ZER ZER
HARD	WARE	GROUP NO. 007					
FOR U	ISE ON	MARK/DOOR #(S): 13A	14A	15A	5A		
	IDE EAGEA	CH SGL DOOR(S) W HINGES FLUSH BOLTS DUST PROOF STR CLASSOOM LOCK SFIC EVEREST CO WALL STOPS ASTRAGAL SILENCERS	RIKE	E FOLLOWING: 5BB1 4.5 X 4.5 NRP FB458-12' DP-2 L9070HD 03B 80-037 WS406/407CCV 41-DOOR HEIGHT SR64		643E 643E 643E 643E 606 613 BK GRY	IVE IVE IVE SCH SCH IVE ZER IVE
HARD	WARE	GROUP NO. 008					
FOR U	JSE ON	MARK/DOOR #(S): 13	14	15	5	7	
PROV 3 1 1 1 3	IDE EAG EA EA EA EA EA	CH SGL DOOR(S) W HINGES OFFICE LOCK SFIC EVEREST CO WALL STOPS SILENCERS		E FOLLOWING: 5BB1 4.5 X 4.5 L9050HD 03B 80-037 WS406/407CCV SR64		643E 643E 606 613 GRY	IVE SCH SCH IVE IVE

HARDWARE GROUP NO. 009

FOR USE ON MARK/DOOR #(S):

21A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

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	REPLACEMENT HEADQUARTERS PHASE 1	

3	EΑ	HINGES	5BB1 4.5 X 4.5 NRP	643E	IVE
1	EA	PASSAGE SET	L9010HD 03B	643E	SCH
1	EA	SURFACE CLOSER	1461 H	695	LCN
1	EA	WALL STOPS	WS406/407CCV	613	IVE
3	EΑ	SILENCERS	SR64	GRY	IVE

HARDWARE GROUP NO. 010

FOR USE ON MARK/DOOR #(S):

21B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGES	5BB1 4.5 X 4.5	643E	IVE
1	EA	OFFICE LOCK	L9050HD 03B	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	1461 H	695	LCN
1	EA	WALL STOPS	WS406/407CCV	613	IVE
3	EA	SILENCERS	SR64	GRY	IVE

HARDWARE GROUP NO. 011

15B

Provide each PR door(s) with the following:

	\ /	0		
)TY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
EA	CONT. HINGE	112HD X DOOR HEIGHT	313	IVE
EA	DEAD BOLT	MS1850S-4089-4001-S4043-4066	313	ADA
EA	FSIC CORE	23-030 EVEREST	606	SCH
EA	CYLINDER	20-060 X AR CAM	643E	SCH
EA	PUSH PULL BAR	9190HDEZ-12"-DOOR WIDTH	643E	IVE
EA	SURFACE CLOSER	4040XP EDA 4040-18PA 4040-30	695	LCN
EA	FLOOR STOP	FS18S	BLK	IVE
EA	DRIP CAP	142BK-HEADER WIDTH + 4"	BK	ZER
EA	DOOR SWEEP	39BK-DOOR WIDTH	BK	ZER
EA	THRESHOLD	655BK-V3-FRAME WIDTH	BK	ZER
	WEATHER STRIP	PROVIDED BY STOREFRONT		
		MFG.		
	EA EA EA EA EA EA	EA CONT. HINGE EA DEAD BOLT EA FSIC CORE EA CYLINDER EA PUSH PULL BAR EA SURFACE CLOSER EA FLOOR STOP EA DRIP CAP EA DOOR SWEEP EA THRESHOLD	EA CONT. HINGE EA DEAD BOLT EA FSIC CORE EA CYLINDER EA PUSH PULL BAR EA SURFACE CLOSER EA FLOOR STOP EA DRIP CAP EA DOOR SWEEP EA THRESHOLD WEATHER STRIP EA DEAD BOLT MS1850S-4089-4001-S4043-4066 EA SURFACE CORE 23-030 EVEREST 20-060 X AR CAM 9190HDEZ-12"-DOOR WIDTH 4040XP EDA 4040-18PA 4040-30 FS18S FS1	EA CONT. HINGE 112HD X DOOR HEIGHT 313 EA DEAD BOLT MS1850S-4089-4001-S4043-4066 313 EA FSIC CORE 23-030 EVEREST 606 EA CYLINDER 20-060 X AR CAM 643E EA PUSH PULL BAR 9190HDEZ-12"-DOOR WIDTH 643E EA SURFACE CLOSER 4040XP EDA 4040-18PA 4040-30 695 EA FLOOR STOP FS18S BLK EA DRIP CAP 142BK-HEADER WIDTH + 4" BK EA DOOR SWEEP 39BK-DOOR WIDTH BK EA THRESHOLD 655BK-V3-FRAME WIDTH BK WEATHER STRIP PROVIDED BY STOREFRONT

HARDWARE GROUP NO. 012

FOR USE ON MARK/DOOR #(S):

22B

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

1	EA	CONT. HINGE	112XY-DOOR HEIGHT	313	IVE
1	EΑ	EXIT HARDWARE	33A-NL/OP	643E	VON
1	EΑ	SFIC RIM CYLINDER	80-159	643E	SCH
1	EΑ	SFIC EVEREST CORE	80-037	606	SCH
1	EΑ	OFFSET PULL	8190-12"-O/F MOUNTING	643E	IVE
1	EΑ	SURFACE CLOSER	4040XP SCUSH 4040-18PA 4040-30	695	LCN
1	EΑ	DOOR SWEEP	39BK LENGTH AS REQ	BK	ZER
1	EΑ	THRESHOLD	655BK-226-FRAME WIDTH	BK	ZER

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08 7100

TPWD TYLER STATE PARK REPLACEMENT HEADQUARTERS PHASE 1

PERIMETER SEAL

PROVIDED BY DOOR/FRAME MFG

HARDWARE GROUP NO. 013 - FIRE RATED

FOR USE ON MARK/DOOR #(S):

22A

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

3	EA	HINGES	5BB1HW 4.5 X 4.5 NRP	643E	IVE
1	EA	EXIT HARDWARE	99-L-F-996L-03-SNB	643E	VON
1	EA	SFIC RIM CYLINDER	80-159	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	1461 HDPA	695	LCN
1	EA	FLOOR STOP	FS441 MS/LA	613	IVE
1	SET	SMOKE SEAL	8145S-BK-PSA-HEAD & JAMBS	BK	ZER

HARDWARE GROUP NO. 014 - FIRE RATED

FOR USE ON MARK/DOOR #(S):

20 8

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

3	EA	HINGES	5BB1 4.5 X 4.5	643E	IVE
1	EA	PRIVACY LOCK W/	L9040 03B L282-722 L583-363	643E	VON
		INDICATOR			
1	EA	SURFACE CLOSER	1461 HD	695	LCN
1	EA	WALL STOP	WS406/407CCV	613	IVE
1	EA	COAT HOOK	582B	643E	IVE
1	SET	SMOKE SEAL	8145S-BK-PSA-HEAD & JAMBS	BK	ZER

HARDWARE GROUP NO. 015

FOR USE ON MARK/DOOR #(S):

24 4A 2B 01 02

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

1	EΑ	CONT. HINGE	112XYDOOR HEIGHT	313	IVE
1	EA	STOREROOM LOCK	L9080HD 03B	643E	SCH
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EΑ	LATCH GUARD	LG-12	630	IVE
1	EA	OH STOP	104S	695	GLY
1	EA	RAIN DRIP	142A DW + 4"	BK	ZER
1	EA	WEATHER STRIP	328S-HEAD & JAMBS	BK	ZER
1	EΑ	DOOR SWEEP	39BK LENGTH AS REQ	BK	ZER
1	EA	THRESHOLD	65-V3-226-FRAME WIDTH	BK	ZER
		DOOR CONTACT	PROVIDED BY DIVISION 28		

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08 7100

TPWD TYLER STATE PARK REPLACEMENT HEADQUARTERS PHASE 1

HARDWARE GROUP NO. 016

FOR USE ON MARK/DOOR #(S):

2 1

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

1	EA	CONT. HINGE	112XY SEC-DOOR HEIGHT	313	IVE
1	EA	CLASSROOM	B663H SEC	643E	SCH
		DEADLOCK			
1	EA	SFIC EVEREST CORE	80-037	606	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT SEC (PULL SIDE	695	LCN
			MOUNTED)		
1	EA	PULL PLATE	8305-8 (3-1/2" X 15")	643E	IVE
1	EA	PUSH PLATE	8200-8" X 16"	643E	IVE
1	EA	WEATHER STRIP	328S-HEAD & JAMBS	BK	ZER
1	EA	DOOR SWEEP	39BK LENGTH AS REQ	BK	ZER
1	EA	THRESHOLD	545-V3-226-FRAME WIDTH	BK	ZER
		DOOR CONTACT	PROVIDED BY DIVISION 28		

HARDWARE GROUP NO. 017

FOR USE ON MARK/DOOR #(S):

9A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

1	EA	LOCK	2331	31:	3 A/R
1	EA	CYLINDER	80-111 X K510-711	64	3E SCH
1	EA	SFIC EVEREST CORE	80-037	60	6 SCH

END OF SECTION

SECTION 08 8000 GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flat Glass Materials.
- B. Insulating glass units.
- C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 2000 Finish Carpentry.
- B. Section 08 4413 Glazed Aluminum Curtain Wall
- C. Section 08 1213 Hollow Metal Doors and Frames
- D. Section 08 5113 Aluminum Windows: Glazing furnished by window manufacturer.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C864 Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- C. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1036 Standard Specification for Flat Glass; 2011.
- E. ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- F. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- G. ASTM E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- H. GANA (SM) GANA Sealant Manual; 2008.

1.04 DEFINITIONS

- A. Sealed Insulating Glass Unit Surfaces:
 - 1. Side 1 Exterior surface of outer pane.
 - 2. Side 2 Interior surface of outer pane.
 - 3. Side 3 Interior surface of inner pane.
 - 4. Side 4 Exterior surface of inner pane.

1.05 SUBMITTALS

- A. See Owner's General Conditions and Special Conditions for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12x12 inch in size of glass and plastic units, showing coloration and design.
- E. Samples: Submit two samples 12x12 inch in size of sealed insulating glass units.
- F. Certificates: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Certificate: Certify that sealed insulated glass meets or exceeds specified requirements.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications, Sealed Insulating Glass Units: Minimum five (5) years of documented experience producing sealed insulating glass units of the type specified in this section.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

1.07 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
- C. Field Measurements: When construction schedule permits, verify field measurements with drawing dimensions prior to fabrication of glass products.

1.08 WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLAZING UNITS

- A. TYPE 1 Sealed Insulating Glass Units, Vision glazing Low-E:
 - 1. Application: Exterior windows.
 - 2. Type: Annealed float glass.
 - 3. Thermal Resistance (U-Value): .50, nominal
 - 4. total Solar Heat Gain Coefficient: .25, nominal
 - 5. Between-lite space filled with argon.
 - 6. Tint: Gray.
 - 7. Low-e coating
 - 8. Outboard Lite: Annealed float glass, 1/4 inch (6 mm) thick, minimum.
 - a. Tint: Grav
 - 9. Inboard Lite: Annealed float glass, 1/4 inch (6 mm) thick.
 - a. Tint: Clear
 - 10. Total Thickness: 1 inch (25 mm).
- B. TYPE 2 - Sealed Insulating Glass Units, Spandrel glazing.
 - 1. Application: Exterior glazing where indicated.
 - 2. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear
 - b. Coating: Same as on vision units, on #2 surface.
 - 3. Inboard lite: Heat-strengthened float glass, 1/4 inch thick.
 - a. Tint: match type 1.
 - b. Opacifier: Ceramic frit, on # 4 surface.
 - 4. Total thickness: 1 inch
 - 5. Glazing Method: Gasket glazing
- C. TYPE 3 Tempered translucent single-pane:
 - 1. Application: All interior glazing unless otherwise indicated.
 - 2. Type: Fully tempered float glass.
 - 3. Tint: Clear.
 - 4. Thickness: 1/4 inch (6 mm).

2.02 EXTERIOR GLAZING ASSEMBLIES

- A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.

- Glass thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

2.03 GLASS MATERIALS

- A. Float Glass Manufacturers:
 - 1. AGC Glass Company North America, Inc: www.us.agc.com/#sle.
 - 2. Guardian Industries Corp: www.sunguardglass.com/#sle.
 - 3. Pilkington North America Inc: www.pilkington.com/na.
 - 4. PPG Industries, Inc: www.ppgideascapes.com/#sle.
- B. Substitutions: Refer to the Owner's General Conditions and Special Conditions.
- C. Float Glass: Provide float glass based glazing unless noted otherwise.
 - 1. Annealed Type: ASTM C1036, Type I Transparent Flat, Class 1 Clear, Quality-Q3.
 - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 - 3. Tinted Types: ASTM C1036, Class 2 Tinted, color and performance characteristics as indicated.
 - 4. Thicknesses: 1/4 inch, unless otherwise indicated on Drawings.
- D. Sealed Insulating Glass Units: Vision glazing, low-E.
 - 1. Applications: Provide this type of glazing in the following locations:
 - a. Metal-Framed Storefronts and exterior doors
 - 2. Outboard Lite: Tempered float glass, 1/4 inch (6 mm) thick, minimum.
 - 3. Inboard Lite: Tempered float glass, 1/4 inch (6 mm) thick.
 - 4. Total Thickness: 1 inch (25 mm).

2.04 SEALED INSULATING GLASS UNITS

- A. Basis of Design: PPG Solarban 70XL (2) + clear
- B. Substitutions: Refer to Owner's General Conditions and Special Conditions.

2.05 GLAZING COMPOUNDS

- A. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, paintable, knife grade consistency; grey color.
- B. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining, paintable; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; grey color.
- D. Silicone Sealant: Neutral curing, pure silicone as specified in Section 07 9000; paintable.

2.06 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option I. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.

- D. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal, black color; widths required for specified installation.
- E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; Black color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant in accordance with manufacturer's instructions.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (610 mm) intervals, 1/4 inch (6.4 mm) below sight line.
- C. Fill gaps between glazing and stops with glazing putty type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.04 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Install Sealant in accordance with Section 07 9000.
- B. Apply glazing tape to glass; butt-joint tape edges; seal joints with sealant.
- C. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- D. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- E. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- F. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch (610 mm) intervals, 1/4 inch (6 mm) below sight line.
- G. Fill gaps between pane and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
- H. Trim protruding tape edge.

3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- Clean glass and adjacent surfaces.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 09 2116 GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Textured finish system.
- I. Water-resistive barrier over exterior wall sheathing.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry

1.03 REFERENCE STANDARDS

- A. ANSI A108.11-SystemDeleted American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).
- B. ANSI A118.9-SystemDeleted American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM C475/C475M Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- E. ASTM C514 Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).
- F. ASTM C557 Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2009).
- G. ASTM C645 Standard Specification for Nonstructural Steel Framing Members; 2014.
- H. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- I. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- J. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board; 2013.
- K. ASTM C954 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- L. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- M. ASTM C1047 Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- N. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- O. ASTM C1178/C1178M Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

- P. ASTM C1280 Standard Specification for Application of Gypsum Sheathing Board; 2013.
- Q. ASTM C1396/C1396M Standard Specification for Gypsum Board; 2014.
- R. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- S. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- T. GA-216 Application and Finishing of Gypsum Board; 2013.
- U. GA-600 Fire Resistance Design Manual; 2015.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing.
- C. Product Data: Provide data on structural properties of metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Product Data: Submit manufacturer's product data for acoustical insulation, acoustical sealants, acoustical sheet caulk, and acoustical accessories.
- F. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- G. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, illustrating finish color and texture.

1.05 MOCK-UP

A. As soon as sample approvals are obtained, erect and finish a room mock-up. Mock-up will be used to evaluate paint finish quality and sheen and shall remain partially painted as a reference standard. Prior to completion, the whole mock-up shall be repainted with the entire approved paint finish system to achieve visual uniformity.

1.06 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C 840.
- B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum ___ years of experience.
- C. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 1/2 inch (13 mm).
 - 3. Paper-Faced Products:
 - a. American Gypsum Company; FireBloc Type X Gypsum Wallboard.
 - b. CertainTeed Corporation; Type X Drywall.
 - c. Georgia-Pacific Gypsum; ToughRock.
 - d. Georgia-Pacific Gypsum; ToughRock Fireguard X.
 - e. Georgia-Pacific Gypsum; ToughRock Fireguard C.
 - f. National Gypsum Company; Gold Bond BRAND Fire-Shield Gypsum Board.

- g. USG Corporation; USG Sheetrock Brand EcoSmart Panels Firecode X: www.usg.com/#sle.
- h. Substitutions: [See Owner's General Conditions and Special Conditions]
- B. Backing Board For Wet Areas:
 - Application: Surfaces behind tile in wet areas including lavatories, including painted wall areas above tile.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Application: Vertical surfaces behind thinset tile.
 - b. Regular Type: Thickness 1/2 inch (12.7 mm).
 - c. Edges: Tapered where exposed to view.
 - d. Products:
 - 1) CertainTeed Corporation; Diamondback 1/2" Tile Backer.
 - 2) Georgia-Pacific Gypsum; DensShield Tile Backer.
 - 3) National Gypsum Company; Gold Bond eXP Tile Backer.
 - 4) Substitutions: [See Owner's General Conditions and Special Conditions]
- C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch (13 mm).
 - 3. Edges: Tapered.
 - Products:
 - a. CertainTeed Corporation; Interior Ceiling Drywall.
 - b. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - c. USG Corporation; 1/2 Inch Sheetrock Brand UltraLight Panels: www.usg.com/#sle.
 - d. Substitutions: [See Owner's General Conditions and Special Conditions]
- D. Sheathing Board: Sizes to minimize joints in place; ends square cut.
 - 1. Thickness: 1/2 inch.
 - 2. Application: Exterior sheathing.
 - 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 - 4. Core Type: Type X, as indicated.
 - 5. Type X Thickness: 1/2 inch (____mm).
 - 6. Edges: Square.
 - 7. Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Exterior Sheathing Type X.
 - b. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing.
 - c. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.
 - e. Substitutions: [See Owner's General Conditions and Special Conditions]
- E. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by ____ inches (____ mm) wide, beveled long edges, ends square cut.
 - Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 - 2. Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc Shaft Liner.
 - b. CertainTeed Corporation; M2Tech Type X Shaftliner.
 - c. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
 - d. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch (51 mm).
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047, rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional cornerbead and control joints, provide detailed metal shape at exposed panel edges. Demonstrate special shape conditions (if any) on samples and mock-up.
- D. Edge Trim: Bead type(s) as detailed.
- E. Joint Materials for Paper-Faced gypsum board: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Ready-mixed vinyl-based joint compound.
 - 4. Chemical hardening type compound.
 - 5. Joint Compound: Setting type, field-mixed.
- F. Joint Materials for Glass Mesh faced backer board: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 - Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Chemical hardening type compound.
- G. Textured Finish Materials: Latex-based compound; plain.
- H. Nails for Attachment to Wood Members: ASTM C514.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.

3.03 FRAMING INSTALLATION

- A. Wood Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/600.
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
 - 1. Extend partition framing as indicated on drawings.
 - 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

- 3. Extend stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
- F. Blocking: Install wood blocking for support of:
 - 1. Framed openings.
 - 2. Toilet partitions.
 - 3. Toilet accessories.
 - 4. Wall-mounted door hardware.
 - 5. Shelving
 - 6. Cabinetry

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated on the Drawings.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound. Full-float finish all exposed glass mat-faced gypsum panels.
- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
 - 1. Install using only joint materials duplicating products approved on samples and mockups.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - a. All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound, plus three separate coats of compound at joints, angles, fasteners, and accessories. Compound shall be smooth and free of tool marks and ridges.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - a. All joints and interior angles shall have tape embedded in joint compound and one separate coat of joint compound applied over all joints, angles, fastener heads, and accessories. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - 3. Level 1: 3" and higher above finished ceilings, whether or not accessible in the completed construction.
 - a. All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Toolmarks and ridges are acceptable.

- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

3.07 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

SECTION 09 3000 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- Tile for wall applications.
- B. Ceramic accessories.
- C. Setting materials: adhesives, mortars, grouts, and sealants

1.02 RELATED REQUIREMENTS

- A. Section 07 9200 Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 09 2116 Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108.12 American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- B. ANSI A108.13 American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- C. ANSI A118.1 American National Standard Specifications for Dry-Set Cement Mortar; 2012 (Revised).
- D. ANSI A118.4 American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- E. ANSI A118.10 American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- F. ANSI A137.1 American National Standard Specifications for Ceramic Tile; 2013.1.
- G. TCNA (HB) Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Samples: Mount tile and apply grout on two 5/8" thick specified tile backer board panels, 24x 48 inches in size illustrating each pattern, color variations, and grout joint size and color variations.
- C. Samples: Submit color samples of uncoupling membrane and corner movement profile from manufacturer's standard color range for selection by Architect.

1.06 MOCK-UP

- A. Refer to Owner's General Conditions and Special Conditions, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.
 - 2. Provide 3 foot wide x wainscot height tall mock-up of each wall tile type.
 - 3. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
- B. Basis of Design:
 - 1. Dal-Tile Corporation: www.daltile.com/#sle.
- C. Glazed Wall Tile:
 - 1. Size: As scheduled in drawings
 - 2. Color(s): As scheduled in drawings
 - 3. Surface Finish: High gloss.

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Substitutions: [See Owner's General Conditions and Special Conditions]

2.03 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 - 2. Products:
 - a. LATICRETE International, Inc; 257 TITANIUM: www.laticrete.com/#sle.
 - b. Substitutions: [See Owner's General Conditions and Special Conditions]

2.04 GROUTS

- A. Basis of Design:
 - LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - a. Color: As selected by architect.
 - 2. Substitutions: [See Owner's General Conditions and Special Conditions]

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to surfaces.
- C. Verify that required wall-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.03 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1A thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
- B. Over interior concrete and masonry install in accordance with The Tile Council of North America Handbook Method W202, thin-set with dry-set or latex-Portland cement bond coat and epoxy emulsion grout.

3.05 CLEANING

A. Clean tile and grout surfaces.

SECTION 09 5100 ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2016.
- D. ASTM E1264 Standard Classification for Acoustical Ceiling Products; 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 4 by 4 inch in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, ____ inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.
- E. Architect's review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.06 EXTRA MATERIALS

A. Provide 1 percent of total acoustical unit area of each type of acoustical unit for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Acoustical Units General: ASTM E1264, Class A.
- B. Acoustical Panels, Type 1: Painted mineral fiber, with the following characteristics:
 - Classification: ASTM E1264 Type III.
 - 2. Size: 24 by 24 inches (610 by 610 mm).
 - 3. Thickness: 3/4 inch (19 mm).
 - 4. Light Reflectance: 83 percent, determined in accordance with ASTM E1264.
 - 5. NRC Range:.5 to.65, determined in accordance with ASTM E1264.

- 6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
- 7. Panel Edge: Square.
- 8. Color: White.
- 9. Surface Pattern: Fine Fissured
- 10. Suspension System Type A: Exposed grid.
- 11. Products:
 - a. Armstrong World Industries, Inc; : www.armstrongceilings.com/#sle.
 - b. USG Corporation; : www.usg.com/ceilings/#sle.
 - c. CertainTeed.
 - d. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
 - Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - 2. Profile: Tee; 15/16 inch (24 mm) face width.
 - 3. Finish: Baked enamel.
 - 4. Color: White.
 - Products:
 - a. Same as acoustical units...
- C. Suspension System for Type ACT 1:

2.03 ACCESSORIES

- Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch (2 mm) galvanized steel wire.
- C. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.
- D. Perimeter Moldings: Same metal and finish as grid.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- E. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- F. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

- G. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- H. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- J. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- K. Do not eccentrically load system or induce rotation of runners.
- L. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - Miter corners.
 - 3. Provide at junctions with other interruptions.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
 - Double cut and field paint exposed reveal edges.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

SECTION 09 5426 SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Linear wood planks.
- B. Metal suspension system.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- C. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2016.
- F. CISCA (WC) Wood Ceilings Technical Guidelines; 2009.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Suspended Wood Ceilings:
 - 1. 9Wood; ____: www.9wood.com/#sle.
 - 2. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 SUSPENDED WOOD CEILING SYSTEM

- A. Performance Requirements:
 - 1. Design for maximum deflection of 1/360 of span.
 - 2. Surface Burning Characteristics: Flame spread index of Class 1 (A), smoke developed index of _____, when tested in accordance with ASTM E84.
- B. Linear Wood Planks: Solid wood.
 - 1. Type: Tongue and Grove
 - a. Plank Thickness: 3/4 inch (19 mm).
 - b. Plank Width: 5 inch (____ mm), nominal.
 - 2. Solid Wood Species: Douglas Fir.
 - a. Factory Finish: Clear sealer.
 - 3. Products:
 - a. 9 Wood 2400 T&G Linear Series 2000, Bases of design.
 - b. Substitutions: [See Owner's General Conditions and Special Conditions]
- C. Metal Suspension System:
 - 1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 - a. Materials:
 - 1) Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 - 2. Concealed Suspension System: Hot-dipped galvanized steel grid and cap.
 - a. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
 - b. Profile: Tee; 15/16 inch (24 mm) face width.
 - c. Products:
 - 1) Same as ceiling system.

- 3. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.
- D. Accessories: Manufacturer's standard accessories for installation method indicated, above-ceiling accessibility.

2.03 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

- A. Coordinate the location of hangers with other work.
- B. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.
- C. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

- A. General: Install suspended wood ceiling system in accordance with CISCA (WC).
- B. Suspension System:
 - 1. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
 - Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
 - Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
 - 4. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
 - 5. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
 - 6. Do not eccentrically load system or induce rotation of runners.

C. Wood Ceiling:

- 1. Install wood ceilings in accordance with manufacturer's instructions.
- 2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
- 3. Install components in uniform plane, and free from twist, warp, and dents.
- 4. Cut to fit irregular grid and perimeter edge trim.
- Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

3.05 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

SECTION 09 6500 RESILIENT BASE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

1.03 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- Product Data: Provide data on adhesive recommended by resilient base manufacturer for installation of specified base.
- Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Wall Base: 10 linear feet (3 linear meters) of each type and color.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect roll materials from damage by storing on end.

1.05 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
 - 1. Height: 4 inch (100 mm).
 - 2. Thickness: 0.125 inch (3.2 mm).
 - 3. Basis of Design: Roppe
 - a. Finish: Matte.
 - b. Color: As selected by architect
 - 4. Accessories: Premolded external corners and internal corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

- A. Prepare substrates as recommended by flooring and adhesive manufacturers.
- B. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of substrate conditions.

- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

SECTION 09 9000 PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Surfaces to be finished are indicated in this section and on the Drawings.
- D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.

E. Do Not Paint or Finish the Following Items:

- 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
- 2. Items indicated to receive other finishes.
- 3. Items indicated to remain unfinished.
- Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
- 5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
- 6. Floors, unless specifically so indicated.
- 7. Ceramic and other tiles.
- 8. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
- 9. Glass.
- 10. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 Structural Steel Framing
- B. Section 05 5200 Handrails and Railing
- C. Section 06 2000 Finish Carpentry
- D. Section 06 4100 Cabinets and Casework
- E. Section 08 1213 Hollow Metal Doors and Frames
- F. Section 09 2116 Gypsum Board Assemblies

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- B. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions., for submittal procedures.
- B. Product Date: Provide data on all finishing products, including VOC content.

- Samples for Initial Selection: For each paint or stain system, submit color options to Architect for selection.
- D. Samples: Submit two painted samples for each paint or stain system, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on actual material substrate, 12x12 inch in size.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, care and cleaning instructions, touch-up procedures, and repair of painted and coated surfaces.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 Product Requirements, for additional provisions.
 - 2. Extra Paint and Coatings: 1 gallon (4 L) of each color; store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- B. Material Quality: Material containers not displaying manufacturer's product identification will not be acceptable.
- C. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.08 MOCK-UP

- A. See Section 01 4000 Quality Requirements, for general requirements for mock-up.
- B. Provide panels, 4 feet long by 2 feet wide, illustrating each coating color, texture, and finish. A maximum of two re-paintings may be required to establish standards to color, texture, sheen, and washability.
- C. Provide door and frame assembly illustrating paint coating color, texture, and finish.
- D. Mock-ups will be used to test paint finish quality including adhesion, hiding power, texture, accepted range of sheen and color variability and other tangible and intangible qualities and shall remain partially painted as a reference standard until direct by the Architect to be completed. At this time the whole mock-up shall be repainted with the entire approved paint finish system to achieve visual uniformity with the adjacent surfaces.
 - Adhesion test will be performed by the Contractor in the Owner's presence on the mock-up. The owner may perform additional adhesion tests as the construction progresses.
- E. Locate where directed.
- F. Mock-up may not remain as part of the work.

1.09 DELIVERY, STORAGE, AND HANDLING

- Conform to manufacturer's instructions.
- Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include 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 reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.10 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Basis of Design:

Paints, Stains and Transparent Finishes:

- 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Substitutions: See Section 01 6000 Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
 - 5. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - Provide coatings that comply with the most stringent requirements specified in the following:
 - 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

- 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: As indicated on drawings
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Steel Unprimed
 - 1. One coat primer; Sherwin Williams Pro-Cryl Universal Primer, 3.0 MDF
 - 2. Two coats high performance acrylic, Sherwin Williams Multi-surface Acrylic, 2.5 MDF per coat
- B. Steel Shop Primed and previously painted surfaces (including mechanical equipment and all door and frames)
 - Touch-up with one coat primer, Shrwin Williams Pro-Cryl Universal Primer, 0.7 MDF
 - Two coats high performance acrylic, Sherwin Williams Multi surface Acrylis, 2.5 MDF per coat
- C. Steel Shop primed; high performance coating
 - 1. One coat primer; Sherwin Williams Pro-Cryl Universal matal Primer, 3.5 MDF
 - 2. Two coats high performance coating; Sherwin Williams Waterbased Acrolon 100 Polyurethane Gloss, 4.0 mils per coat.
- D. Steel Galvanized
 - 1. One coat primer; Shrwin Williams Pro-Cryl Universal Primer, 4.0 MDF
 - 2. Two coats high performance alkyd Enamel; Sherwin Williams Urethane Alkyd Enamel, 2.5 MDF per coat.
- E. Wood Transparent finish
 - 1. One coat tinted wood filler for open grain woods
 - 2. Two coats Sherwin Williams Super Deck Exterior Oil Based Transparent Stain

2.04 PAINT SYSTEMS - INTERIOR

- A. Steel Shop primed (including fire extinguisher cabinets and all doors and door frames)
 - Touch-up with one coat primer; Sherwin Williams Pro-Cryl Universal Primer, 2.0 MDF
 - 2. Two coats high performance acrylic; Sherwin Williams Multi-Surface Acrylic, 2.5 MDF.
- B. Gypsum Board
 - 1. One coat texture, light orange peel.
 - 2. One coat PVA primer/sealer; Sherwin Williams ProGreen 200 Latex Wall primer; 1.1 MDF
 - 3. Two coats acrylic latex paint; Sherwin Williams Pro Mar Zero VOC Acrylic Eg-Shel; 1.6 MDF per coat.
- C. Gypsum Board to receive Epoxy Coating
 - One coat texture, light orange peel.
 - 2. One coat primer/sealer; Sherwin Williams ProMar 200 Zero VOC primer; 1.1 MDF
 - 3. Two coats water-based epoxy; Sherwin-Williams Pro Industrial Pre-Catalyzed Epoxy, Eg-Shel; 1.6 MDF per coat
- D. Wood Transparent finish
 - 1. One coat tinted filler for open grain woods.
 - Two coats semi-transparent oil stain: Sherwin Williams Wood Classics Oil Stain
 - 3. Three coats Sherwin Williams Wood Classics Oil Based Varnish, Satin; 1.3 MDF per coat.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing coatings that exhibit surface defects. Sand and feather out transitions between infill work and existing painted surfaces.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Provide barrier coats over incompatible primers and paints or remove and reprime. Notify architect in writing of problems anticipated with using the specified finish-coat material with substrates painted or primed by others.
- H. Touch-up bare areas where finish removals have exposed substrates. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with a suitable primer as specified herein.
- Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- J. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- K. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance. Apply additional coats where undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and

- appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
- F. Use applications and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
- G. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- H. Sand wood and metal surfaces lightly between coats to achieve required finish.
- I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- J. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

3.06 SCHEDULE - SURFACES TO BE FINISHED

- A. Do not paint or finish the following items, unless otherwise noted:
 - 1. Fire rating labels, equipment serial numbers and capacity labels.
 - 2. Gold leaf, metalic paint, galvanized steel, aluminized steel, prefinished wood work, copper chrome, stainless steel, galvalume, or brass items
 - 3. Items fully factory finished unless otherwise noted
 - 4. Exterior storefront door and frame systems.
- B. PT-1: Painted ceilings, interior walls, interior door trim.
 - 1. Color: SW 7005 Pure White
 - 2. Manufacturer: Sherwin-Williams
- C. PT-2: Interior HM doors.
 - 1. Color: Custom-match accent color of ceramic tile.
 - 2. Manufacturer: Sherwin-Williams
- D. PT-3: Exterior HM doors and Trim, exterior galvanized steel.
 - 1. Color: SW 7065 Argos
 - 2. Manufacturer: Sherwin-Williams

SECTION 10 1100 VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards
- B. Tackboards

1.02 REFERENCE STANDARDS

- A. ANSI A208.1 American National Standard for Particleboard; 2009.
- B. ASTM A424/A424M Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.03 SUBMITTALS

- A. See TPWD UGC/Special Conditions, for submittal procedures
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, and trim.
- E. Test Reports: Show compliance to specified surface burning characteristics requirements.
- F. Manufacturer's printed installation instructions.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Data: Include data on regular cleaning, stain removal.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.05 WARRANTY

- A. See TPWD UGC/Special Conditions, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A.	Claridge Products and Equipment, Inc;: www.claridgeproducts.com/#sle.
B.	Nelson Adams NACO;: www.nelsonadamsnaco.com/#sle.
C.	Polyvision Corporation;: www.polyvision.com/#sle.

2.02 VISUAL DISPLAY UNITS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Height: 24 inches (___ mm).
 - 6. Length: 36 inches (mm), in one piece.
 - 7. Frame: Solid wood, with concealed fasteners.
 - 8. Accessories: Provide marker tray.
 - Manufacturers:
 - a. Claridge; Mix Contemporary Dry Erase Board, bases of design.

- b. Substitutions: Refer to Owner's General Conditions and Special Conditions.
- B. Tackboards: Fine-grained, homogeneous natural cork.
 - Cork Thickness: 1/4 inch (6 mm).
 - 2. Color: As selected from manufacturer's full range.
 - 3. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
 - 4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 - 5. Height: 24 inches (___ mm).
 - 6. Length: 36 inches (mm), in one piece.
 - 7. Frame: Same type and finish as for markerboard.
 - Manufacturers:
 - a. Claridge; Mix Contemporary Dry Erase Board, bases of design.
 - b. Substitutions: Refer to Owner's General Conditions and Special Conditions..

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Foil Backing: Aluminum foil sheet, 0.005 inch (0.13 mm) thick.
- D. Adhesives: Type used by manufacturer.

2.04 ACCESSORIES

- Wood Frames: Factory assembled Ash Wood, with factory applied stained and varnished finish.
- B. Marker Tray: Wood; species and finish to match frame with metal accent strip, metal color as selected from manufacturer's full range.
- C. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Remove temporary protective cover at Date of Substantial Completion.

SECTION 10 1400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Room and door signs.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 Accessible and Usable Buildings and Facilities; 2009.

1.03 FIELD CONDITIONS

- Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. Modulex.
 - 2. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 Texas Accessibility, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille
 - 3. Character Height: 1-1/2 inch (37 mm).
 - 4. Sign Height: 3 inches (75 mm), unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: Clear.
 - 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/8 inch (3 mm).

2.05 ACCESSORIES

A. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 - 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

SECTION 10 2113.13 METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal toilet compartments.
 - Floor-mounted toilet compartments.
 - 2. Wall-mounted urinal screens.
- B. Compartment installation hardware.
- C. Compartment door hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Blocking and supports.
- B. Section 10 2800 TOILET ACCESSORIES.

1.03 REFERENCE STANDARDS

- A. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number144, Rules and Regulations.
- B. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 SUBMITTALS

- A. See Owner's General Conditions and Special Conditions for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings:
 - 1. Dimensioned plans indicating layout of toilet compartments.
 - Dimensioned elevations indicating heights of doors, pilasters, separation partitions, and other components; indicate locations and sizes of openings in compartment separation partitions for toilet and bath accessories to be installed in partitions; indicate floor and ceiling clearances.
 - 3. Details indicating anchoring components and methods for project conditions; indicate components required for installation, but not supplied by toilet compartment manufacturer
- D. Samples: Submit sample of partition panels, 3x3" inch size illustrating panel finish, color, and sheen of panel at corner.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.
- C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- D. Obtain accessory manufacturer's installation instructions and installation templates for toilet and bath accessories to be installed in compartment separation partitions; supply instructions and templates to installer before beginning construction activities of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Toilet Compartments:
 - 1. Basis of Design: RIGIDIZED METALS CORP: www.rigidized.com

2. Substitutions: Owner's General Conditions and Special Conditions

2.02 MATERIALS

- A. Basis of Design:
 - 1. RIGIDIZED METALS CORP., Type 304 SS, .036 gauge, pattern 5-wl, satin finish.

2.03 COMPONENTS

- A. Toilet Compartments: Stainless steel, floor-mounted unbraced.
- B. Panels:
 - Nominal thickness: 1 inch.
 - 2. Core: Kraft honeycomb, impregnated with water-resistant resins.
 - 3. Face sheets: 0.032 +/- 0.002 inch stainless steel sheet, No. 4 satin finish, stretcher-leveled; bonded under pressure to core with non-toxic adhesive.
 - 4. Welded edge moldings on all edges forming rigid frame around component.
 - Edges: 0.032 +/- 0.002 inch stainless steel interlocking molding, with molding corners welded to each other and to face sheets; welds ground smooth and polished to match faces
 - b. At Contractor's option, provide Mills 'Permaseal' interlocking watertight edge, brazed and ground smooth.

C. Urinal Screens:

- 1. Nominal thickness: 1/2", minimum.
- 2. Core: Kraft honeycomb, impregnated with water-resistant resins.
- 3. Face sheets: 0.032 +/- 0.002 inch stainless steel sheet, stretcher-leveled; bonded under pressure to core with non-toxic adhesive.
- 4. Edge Moldings: 0.032 +/- 0.002 inch stainless steel interlocking molding, with molding corners welded to each other and to face sheets; welds ground smooth and polished to match faces.
- 5. Welded edge moldings on all edges forming rigid frame around component.
- 6. At Contractor's option, provide Mills 'Permaseal' interlocking watertight edge, brazed and ground smooth.

D. Pilasters:

- 1. Nominal thickness: 1-1/4 inches.
- 2. Core: Kraft honeycomb, impregnated with water-resistant resins.
- 3. Face sheets: 0.046 +/- 0.002 inch stainless steel sheet, No. 4 satin finish, stretcher-leveled; bonded under pressure to core with non-toxic adhesive; sides and top sealed with edge molding.
- 4. Edge Moldings: 0.032 +/- 0.002 inch stainless steel interlocking molding, with molding corners welded to each other and to face sheets; welds ground smooth and polished to match faces.
- 5. Welded edge moldings on all edges forming rigid frame around component.
- 6. At Contractor's option, provide Mills 'Permaseal' interlocking watertight edge, brazed and ground smooth.
- 7. Reinforcement for installation: Inverted stirrup bracket, 0.516 +/- 0.002 inch, with adjusting jack bolt, welded within pilaster base.

E. Doors:

- 1. Nominal thickness: 1 inch.
- 2. Core: Kraft honeycomb, impregnated with water-resistant resins. Face sheets: 0.032 +/- 0.002 inch stainless steel sheet, No. 4 satin finish, stretcher-leveled; bonded under pressure to core with non-toxic adhesive.
- Edge Moldings: 0.032 +/- 0.002 inch stainless steel interlocking molding, with molding corners welded to each other and to face sheets; welds ground smooth and polished to match faces.
- 4. Welded edge moldings on all edges forming rigid frame around component.

- 5. At Contractor's option, provide Mills 'Permaseal' interlocking watertight edge, brazed and ground smooth.
- F. Door and Panel Dimensions:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Core: Kraft honeycomb, impregnated with water resistant resins.

2.04 ACCESSORIES

- A. Pilaster Shoes: One-piece Type 304 stainless steel assembly, No. 4 satin finish, having an internal cross section conforming to the pilaster; held in place with concealed fastening clips.
 - 1. Height: 3 inches.
- B. Urinal Screen Mounting Brackets:
 - Mounting Brackets shall be fabricated of full height continuous type 304 stainless steel sheet finished to match the panel and shall be mounted to continuous blocking inside of wall.
 - 2. Fasteners at locations connecting brackets to panels shall utilize through bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Through-bolted fasteners shall withstand direct pull force exceeding 1,500 lbs. per fastener.
 - 3. Wall mounted screen brackets shall be 11 gauge, 0.116 +/- 0.002 inch (3 mm), double continuous stainless steel angles with edges eased and deburred.
- C. Head Rail: Extruded anodized aluminum rail with anti-grip device; secured at the wall with stainless steel brackets.
- D. Wall Brackets: Provide doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, and to attach to adjacent assemblies as indicated.
 - 1. Brackets shall be attached to pilasters by one-way, stainless steel machine screws into threaded metal inserts.
 - 2. Back to back brackets shall be attached to partition by one-way, stainless steel throughbolts of same material and finish with tamper-resistant heads into threaded metal inserts. Build-in stainless steel inserts as indicated or required to complete installation.
 - 3. Brackets shall be attached to adjacent construction by one-way, stainless steel bolts and fasteners of same material and finish with tamper-resistant heads into threaded metal inserts. Provide stainless sleeves, inserts and shims as indicated or required to complete installation.
- E. Brackets: Die-cast No. 304 stainless steel, No.4 satin finish, with throughbolts and fasteners of same material and finish with tamper-resistant heads.
- F. Door Hardware: Die-cast No. 304 stainless steel, with No.4 satin finish.
 - 1. Maximum displacement from indicated position: 1/8 inch.
 - 2. Top Hinges: Recessed and interlocked in door with nylon pin in the plane of the door, through-bolted. Hinges shall comply with TAS 604.8.1.2.
 - 3. Bottom Hinge: Recessed in door, with mating box and pintle, nylon cams providing the bearing surface; adjustable to allow door to rest at any position within a 270-degree range; through-bolted. Hinges shall comply with TAS 604.8.1.2.
 - 4. Hardware
 - a. All hardware to be 18-8, type 304 stainless steel with satin finish.
 - b. Hardware of chrome plated "Zamac" is unacceptable.
 - Vandal Resistant Latch
 - a. Sliding door latch shall be 14-gauge (2mm) and shall slide on nylon track.
 - b. Sliding door latch shall require less than 5 lb force to operate. Twisting latch operation will not be acceptable.
 - c. Latch track shall be attached to door by theft resistant one-way stainless steel machine screws into factory installed metal inserts.
 - d. Latch handle shall have rubber bumper to act as door stop.
 - e. Latch shall allow door to be lifted over 11-gauge (3mm) keeper for emergency access.

- f. Metal to metal connection shall withstand a direct pull of over 900 lbs per screw.
- 6. Stop and Keeper: Through bolted.
- 7. Coat Hook and wall bumper combination inside stalls: Surface mounted. At stalls required to be accessible, mount at 48" AFF.
- 8. Fastening Hardware: Tamper-resistant heads.
- 9. Door Pulls
 - a. Comply with TAS 404.2.7.
 - b. Provide door pulls on outswinging compartment doors.
 - c. Provide door pulls on both sides of wheelchair accessible toilet compartment doors near the latch, as required by TAS 604.8.1.2.
- G. Hook and wall bumpers outside stalls: Surface mounted. Refer to Section 10 2800.
- H. Toilet Accessories for Installation in Compartment Separation Partitions: Refer to Section 10 2800.

2.05 FABRICATION

A. No slices or joints in faces shall be acceptable

PART 3 EXECUTION

4.01 DELIVERY STORAGE AND HANDLING

- A. Do not deliver materials or begin construction activities of this section until building is enclosed, with complete protection from outside weather, and building temperature maintained at a minimum of 60 degrees F
- B. Store compartment components in un opened cartons in vertical position until installation, with adequate support to ensure flatness and to prevent damage to surface.

4.02 INSPECTION

- A. Check areas scheduled to receive screens for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
- Verify spacing of plumbing fixtures to assure compatibility and alignment with installation of screens.
- C. Do not begin installation of screens until conditions are satisfactory.

4.03 EXAMINATION

- A. Verification of existing conditions
 - 1. Verify that field measurements are as indicated.
 - 2. Verify correct spacing of and between plumbing fixtures.
 - 3. Verify correct location of built-in framing, anchorage, and bracing.
- B. Installer's Examination:
 - 1. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
 - 2. Transmit two copies of installer's report to Architect within 24 hours of receipt.
 - 3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.

4.04 PREPARATION

- A. Surface Preparation:
 - 1. Prepare openings in compartment separation partitions for toilet and bath accessories to be installed in partitions; marring of partition finish is prohibited.
 - 2. Locate openings in accordance with shop drawings and accessory manufacturer's installation instructions and templates. Verify ADA clearances.

4.05 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Secure units in position with manufacturer's recommended anchoring devices.
- B. Install compartments to specified tolerances in accordance with shop drawings and manufacturer's printed installation instructions.
- C. Attach components to adjacent materials and to other components using purpose-designed fastening devices. Verify ADA mounting heights and location.
- D. Adjust pilaster anchors for floor variations; conceal anchors with pilaster shoes.
- E. Maintain 3/8 to 1/2 inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.
- F. Attach panel brackets securely to walls using anchor devices.
- G. Attach panels and pilasters to brackets.
- H. Equip each compartment door with one coat hook and one wall bumper which may be combined as appropriate.
- Field touch-up of scratches or damaged enamel finish will not be permitted. Replace damaged or scratched materials with new materials.

4.06 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).
- C. Provide clearances of not more than ½" (6mm) between pilasters and panels and 3/8" (9mm) between panels and walls.

4.07 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.
- D. Adjust door hardware to align door strike keeper on each pilaster with door latch.

4.08 PROTECTION OF INSTALLED PRODUCTS

- A. Prevent damage to product finishes by subsequent construction activities.
- B. Repair damaged finishes; replace components having damaged finish if repair is not possible.
- C. Remove factory protective coverings and clean finish surfaces in accordance with manufacturer's instructions before final inspection.

SECTION 10 2800 TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.
- B. Section 10 2113.13 Metal Toilet Compartments.

1.03 REFERENCE STANDARDS

- ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A269/A269M Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM C1036 Standard Specification for Flat Glass; 2011.
- F. ASTM C1503 Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).
- G. GSA CID A-A-3002 Mirrors, Glass; U.S. General Services Administration; 1996.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.06 WARRANTY

- A. Provide fifteen year manufacturer warranty against silver spoilage for reflective coating on mirrors and replacement of same.
- B. See Owner's General Conditions and Special Conditions, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Bobrick.
- B. Substitutions: Section 01 6000 Product Requirements.

2.02 MATERIALS

- A. Accessories General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Adhesive: Contact type, waterproof.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on product data.
- E. See Section 06 1000 Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions, except where more stringent requirements are mandated by governing authorities, and except where the project conditions require extra precautions or provisions.
- 3. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.04 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers and Accessories:
 - 1. Basis of Design: Ansul, a Tyco Business; Cleanguard: www.ansul.com.
 - 2. Substitutions: See Section 01 6000 Product Requirements.

2.02 FIRE EXTINGUISHERS

- Fire Extinguishers General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound (4.54 kg) min.
 - Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ____ degrees F (____ degrees C).

2.03 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install extinguisher 48 inches from finished floor to bottom of extinguisher.
- C. Secure rigidly in place.

END OF SECTION

SECTION 10 7500 FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 REFERENCE STANDARDS

- A. ASTM B241/B241M Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.
- B. NAAMM FP 1001 Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.03 SUBMITTALS

- A. See TPWD UGC/Special Conditions, for submittal procedures
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

PART 2 PRODUCTS

2.01 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001.
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.
 - 3. Mounting: Ground mounted type.
 - 4. Nominal Height: 30 ft (____ m); measured from nominal ground elevation.
 - 5. Halyard: External type.
- B. Performance Requirements:
 - 1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 90 miles/hr (____ km/hr) wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.02 POLE MATERIALS

A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.03 ACCESSORIES

- A. Finial Ball: Aluminum, 8 inch (mm) diameter with flag illumination.
- B. Cleats: 9 inch (230 mm) size, stainless steel with stainless steel fastenings, two per halyard.
- C. Halyard: 3/8 inch (9 mm) diameter polypropylene, braided, white.

2.04 MOUNTING COMPONENTS

- A. Pole Base Attachment: Flush; steel base with base cover.
- B. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.05 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Aluminum: Mill finish.
- C. Stainless Steel: No. 4 satin finish.
- D. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- B. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1 inch (25 mm).

3.04 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 12 2400

WINDOW SHADES - MECHOSHADE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

Manual roller shades and accessories.

1.02 REFERENCE STANDARDS

- A. NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.
- B. WCMA A100.1 Safety of Corded Window Covering Products; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Refer to Owner's General Conditions and Special Conditions, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product to be used including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Operation and Maintenance Data: List of all components with part numbers, and operation and maintenance instructions; include copy of shop drawings.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum ten years of documented experience with shading systems of similar size, type, and complexity; manufacturer's authorized representative.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.06 WARRANTY

- A. See Owner's General Conditions and Special Conditions, for additional warranty requirements.
- B. Provide manufacturer's standard, non-depreciating warranty, for interior shading only, covering the following:
 - 1. Shade Hardware: 10 years unless otherwise indicated.
 - 2. Shade Fabric: 10 years unless otherwise indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: MechoShade Systems LLC; www.mechoshade.com/#sle.
- B. Substitutions: [See Owner's General Conditions and Special Conditions]

2.02 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.

- B. Roller Shades[] Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com/#sle.
 - 1. Description: Single roller, manually operated fabric window shades.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
 - 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - 5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on a oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.
 - Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
 - 6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.

2.03 SHADE FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large or small scale test.
 - 2. Products:
 - MechoShade Systems LLC Inc; Soho 1600 Series (3% open): www.mechoshade.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.03 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.04 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Cabinets and Casework.

1.03 REFERENCE STANDARDS

- A. ISFA 3-01 Classification and Standards for Quartz Surfacing Material; 2013.
- B. MIA (DSDM) Dimensional Stone Design Manual; VIII, 2016.
- C. NEMA LD 3 High-Pressure Decorative Laminates; 2005.
- D. PS 1 Structural Plywood; 2009.

1.04 SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: 3/4 inch (19 mm), minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
 - b. Finish on Exposed Surfaces: Honed.

- c. Color and Pattern: As indicated on drawings.
- 3. Other Components Thickness: 3/4 inch (19 mm), minimum.
- 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
- 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.
- C. Cut holes and install grommets in locations directed by architect / owner. Provide one grommet per counter and one additional for each 6'-0" of counter length.

3.02 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.03 CLEANING

A. Clean countertops surfaces thoroughly.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders govern work under this section and all of Division 22.
- B. This section is in particular reference to and shall be considered a part of all Plumbing specifications sections following. It is intended that comments in this section be applicable to all parts of Division 22. Work described hereinafter shall be included as though written within each specific section of the specification.
- C. The Contractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on the Drawings and/or herein, including all labor, materials, equipment, and incidentals necessary and required for their completion.
- D. All work shall conform to requirements of all local construction codes, applicable sections of the National Fire Protection Association, Public Health Agencies and the Texas Accessibilities Standards, latest editions of all publications.

1.02 SECTION INCLUDES

- Mechanical Sleeve Seal.
- B. Sleeves.
- C. Escutcheons.
- D. Grout.

1.03 SCOPE

- A. Requirements specified in this section shall govern applicable portions of all plumbing sections including paragraphs on related electrical work, whether so stated therein or not.
- B. Where items specified in the specific plumbing sections conflict with requirements in this section, the former specific sections shall govern.
- C. The Contractor shall furnish all labor, plant, equipment, and materials, complete in connection with the installation of the plumbing systems in strict accordance with this specification and accompanying plans. The Contractor shall submit his bid based on performing all work hereinafter specified or indicated on applicable plans. The Contractor shall furnish and install all connections and appurtenances necessary and usually furnished in connection with such work and systems even though not specifically mentioned or shown on the plans.
- D. These requirements cover information, work, equipment and accessories listed under the following headings:
 - 1. References, Definitions, Procedures
 - 2. Permits and Fees
 - 3. Utility Connections and Inspections
 - 4. Workmanship
 - 5. Mechanical Provisions
 - 6. Electrical Provisions
- E. Work of Other Sections:
 - 1. Requirements given within this Section apply to the Work of all Sections of this Division.
- F. Finish painting is specified in other Divisions. Prime and protective painting shall be provided under this Division.

G. Electrical interlock apparatus and other electrical apparatus, which is not an integral part of equipment specified under this Division, are specified under Division 26. Necessary conduit, wiring, boxes, and fittings are specified under Division 26.

1.04 REFERENCES

- A. References to standards, codes, specifications and recommendations shall mean the latest edition of such publications adopted and published at date of invitation to submit Proposals.
- B. References to technical societies, trade organizations and governmental agencies is made in plumbing work sections in accordance with the following abbreviations:

AGA American Gas Association
 AIEE American Institute of Electric

AIEE American Institute of Electrical Engineers
 ANSI American National Standards Institute
 ASME American Society of Mechanical Engineers
 ASTM American Society for Testing and Materials

6. AWWA American Water Works Association

7. FM Factory Mutual

8. NFPA National Fire Protection Association

9. NBS National Bureau of Standards

10. NEC National Electrical Code (NFPA Pamphlet No. 70)11. NEMA National Electrical Manufactures Association

12. UL Underwriters' Laboratories, Inc.

1.05 DEFINITIONS

- A. Definitions of terms and expressions used in plumbing work are:
 - 1. "Provide" shall mean "furnish and install" or "furnish labor and material required for installation of."
 - 2. "Herein" shall mean the contents of a particular section where this term appears.
 - 3. "Indicated" shall mean "indicated on contract drawings."
 - 4. "Section" shall mean one of the portions of plumbing, mechanical or electrical work sections indexed in Division 22, 23 and 26.
 - 5. "Concealed" where used in connection with insulation and painting of piping, and accessories, shall mean that they are hidden from sight as in chases, furred spaces, or hung ceilings.
 - 6. "Exposed" where used in connection with insulation and painting of piping, and accessories shall mean that they are not "concealed" as defined herein above.
 - 7. "Piping" includes in addition to pipe, also fittings, valves, hangers and other accessories, which comprise a system.

B. Drawings and Instructions

1. Contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, fixtures, piping and approximate sizes and locations of equipment and outlets. Plumbing trade shall follow these drawings in laying out their work, consult other trades and general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify and coordinate spaces in which their work will be installed. The contract drawings shall be considered as a part of these specifications. It is intended that any Contractor making proposal to execute any work should study the drawings for his own particular trade, as well as all drawings of all other trades in order to fully understand the work he is expected to perform. As a qualification for bidding, the contractor shall visit the site and be responsible for determining all existing conditions in as far as it affects his work prior to submitting a proposal.

1.06 DRAWINGS

A. General

1. The Drawings are schematic in nature and indicate approximate locations of the plumbing equipment, fixtures and piping systems, except where specific locations are

noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the building. Locate all items by on-the-job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Location:

Prior to locating plumbing fixtures and plumbing items, obtain the Architect/Engineer's
approval as to exact location. Locations shall not be determined by scaling drawings.
Plumbing fixtures, shall be mounted at the heights directed by the Architect/Engineer or
as required by pertinent standards, codes or regulations. Contractor shall be responsible
for costs of redoing work of trades necessitated by failure to comply with this
requirement.

1.07 DISCREPANCIES

A. Clarification:

1. Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Contractor Agreement:

- 1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.
- C. The drawings intend that all equipment and piping be arranged as shown with necessary minor rearrangements to suit the equipment approved and to comply with the requirements of the various equipment manufacturers' recommendations. Some minor rearrangements are expected to best fit the structural conditions. It shall be the responsibility of the Contractor to make known his desires in such change, by shop drawings as required, to obtain agreement of the Architect/Engineer before proceeding with any change or variation. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner.

1.08 PRODUCT SUBSTITUTION PROCEDURES

- A. Architect/Engineer will consider requests for Substitutions. Architect/Engineer shall receive such requests a minimum of 10 days prior to scheduled bid date.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Bidder:
 - Has investigated proposed product and has determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:

- Submit two copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
- 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
- 3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1.09 SUBMITTALS

- A. Submittal Procedures: See TPWD UGC/Special Conditions, for submittal requirements in addition to the following:
 - 1. Submittal Preparation:
 - a. Minimum of six copies are required, complete (all items submitted at one time), index to each Section of Specifications and include the following information and action taken.
 - 1) Project Name
 - 2) Date
 - 3) Name and Address of Architect
 - 4) Name and Address of Engineer (See Division 01 of Specifications)
 - 5) Name, Address and Telephone Number of Contractor or Sub-contractors.
 - 6) Manufacturer's Name
 - 7) Published ratings or capacity data
 - 8) Detailed equipment drawing for fabricated items
 - 9) Wiring diagrams
 - 10) Installation instructions
 - 11) Other pertinent data
 - 12) All required submittals and data, bound together, submitted at one time.
 - b. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with a highlighter pen, or other means of identification clearly legible.
 - c. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such Contractor default shall be allowed.
- B. Submittal Organization:
 - 1. Organize all required data in a 3-ring black (in color) binder of sufficient size (3 inch) with index tabs with number and appropriate title of specification section.
- C. Provide a cover sheet and an index sheet listing all items submitted.
- D. The second and third sheet shall be blank for stamping of submittals. All submittals are to be processed at same date; partial submittals will not and are not acceptable.
- E. Show any revisions to equipment layout required by use of selected equipment. The Engineer shall receive submittals no later than thirty (30) working days from contract date with General Contractor and Owner.
- F. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.10 SHOP DRAWINGS, DESCRIPTIVE DATA

A. As soon as practical and within thirty days after the official award of contract and before any materials and equipment are purchased, the Contractor shall submit to the Architect/Engineer, for review, five (5) copies of the complete list of all materials and equipment identified and referenced to specification paragraphs together with applicable

shop drawings. In addition, the names and addresses of the manufacturers, their catalog data, numbers, and trade names shall be furnished. Published performance data indicating pressure drops, pump curves, balance points, etc., shall be furnished to indicate compliance with scheduled performance. For all fans and pumps, provide the "family" of curves, not just the selected performance point (minimum size 8 ½" x 11"). This data will be marked "Reviewed" by the Engineer, dated and distributed to the several parties involved, with two (2) copies returned to the Contractor. The data shall include the following:

- 1. Equipment-room layouts drawn to ¼" scale, including equipment, piping, accessories, to show clearances for operating and servicing.
- 2. Equipment and materials as indicated in each Section.
- 3. Wiring diagrams, control panelboards, motor test data, motor starters and controls for electrically operated equipment furnished by plumbing trades.
- 4. Composite drawings of crowded locations where there is a possibility of conflict among trades.
- 5. Indicate exact locations and elevations of pipes, ducts, and conduits, obtained from field measurements, after consultation and agreement among trades involved.

B. Verification of Dimensions:

- 1. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall verify all dimensions in the field and advise the Architect/Engineer of any discrepancy before performing the work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner.
- C. Equipment other than that shown should be used in bids only when approved by the Engineer prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, electrical work, connections, piping, etc. which shall be paid for by the Contractor. In the event that the Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect/Engineer reserves the right to reject this equipment, and the Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:

- 1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions.
- E. Submit such directions to Architect/Engineer prior to time of installation for use in review of the work.
- F. Operating Instructions, Charts:
 - 1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect/Engineer, require such instructions; obtain receipt for it.
- G. When so specified or instructed, mount operating instructions in approved frame with glass over; locate where directed.

1.11 GENERAL INSTALLATION

- A. Lines and Grades:
 - Construct work in conformity with lines and grades as indicated, using axis lines and bench marks provided under General Construction; verify such axis lines and bench marks.
 - 2. Axis lines within building will be so spaced on each floor level that plumbing work may be laid out with tape measure having length of 50 feet maximum.

3. Bench marks outside building will be at accessible points on building walls, from which lines and grades required for installation of plumbing and electrical work may be set.

B. Existing Services:

- 1. Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect/Engineer.
- 2. Inactive Services: When encountered in work, remove, cap, or plug inactive services.
- 3. Interruption of Services: Where work makes temporary shutdowns of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

C. Equipment Design and Installation:

- 1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purpose shall be the product of same manufacturer.
- 2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, AIEE or other applicable technical standards, be suitable for maximum working pressure and shall have neat and finished appearance.
- 3. Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation; install so that connecting and disconnecting of piping and accessories can be made readily, and so that all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from indicated arrangements may be made, as approved.

D. Protection of Equipment and Materials:

- 1. Responsibility for care and protection of plumbing work rests with the Contractor until it has been tested and accepted.
- 2. After delivery, before and after installation, protect equipment and materials against theft, injury or damage from all causes.
- 3. Protect plumbing fixtures and other equipment with enamel or glaze surface, from damage, by covering and/or coating, as recommended in Bulletin, "Handling and Care of Enameled Cast Iron Plumbing Fixtures," issued by Plumbing Fixture Manufacturers Association, and as approved.

E. Adjustments:

1. It shall be the responsibility of the Contractor to adjust properly any and all equipment and devices and to run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications. If for some reason any piece of equipment does not function satisfactorily after the first adjustments are made, the Contractor shall continue on the job until satisfactory corrections and adjustments have been made. The Contractor is responsible for the proper performance, functioning, integration, and balance of all equipment. Where tests are required by the Architect/Engineer to ascertain equipment capacities in the installed condition, it shall be the responsibility of the Contractor to run approved tests, to provide all required instruments and apparatus and to submit certified statements of test results. All such instruments shall be in proper calibration and shall meet approval of the Architect/Engineer.

F. Completeness:

1. The Contractor shall be responsible for the absolute completeness of his work, including all adjustments and all final balancing to obtain proper operation in all respects.

- Balancing is in reference to proper water flow, control calibration or balancing to eliminate objectionable vibrations, noises, or surges.
- 2. Each system is intended to be complete and functional in performance. All such items as piping trim, electrical work, controls, accessories, insulated condensate drains and appurtenances required shall be installed at no extra cost.

1.12 PERMITS AND FEES

A. All building permits and their required fees, extension of utilities together with applicable meters, and all inspection fees for all plumbing work shall be arranged and paid for by the Plumbing trade involved in the particular work for which the permit is taken, and for the pertinent inspection fee for the work involved by the Contractor.

1.13 UTILITY CONNECTIONS AND INSPECTIONS

A. Extensions:

1. The Contractor shall provide or obtain and pay for all utility connections, utility extensions, and/or relocations and shall pay all costs and inspection fees for all work included therein.

B. Compliance:

1. The Contractor is required to comply in every respect with all requirements of local inspection departments, local ordinances and codes, and utility company requirements.

C. Utilities:

1. The Contractor shall check with the various utility companies whose services are required for this project and shall provide, complete in all respects, the required utility relocations, extensions, modifications, and/or changes.

D. Certifications:

1. Prior to final acceptance, the Contractor shall furnish without additional charge a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract.

E. Utility Locations and Elevations:

1. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations, and availability of all utilities and services required, and shall adequately inform himself as to their relation to the work. The submission of bids shall be deemed evidence thereof.

F. Ordinances, Rules and Regulations:

- 1. All installations shall comply with applicable codes; ordinances and regulations except where drawings require a higher degree of work as indicated on the plans or specified hereinafter.
- G. Installations and equipment shall comply with applicable requirements of the National Fire Protection Association, American Gas Association, Texas State Board of Insurance Underwriters, utility company, or other local, State or Federal agencies having jurisdiction. Compliance with these requirements shall be done at no additional cost to the Owner.
- H. Any changes to the contract required by the aforementioned requirements shall be submitted to the Architect/Engineer in writing for approval prior to execution.

1.14 WORKMANSHIP

A. All materials and equipment shall be installed in accordance with the approved recommendation of the manufacturer, and by workmen skilled in the trade involved shall accomplish the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.16 ASBESTOS ABATEMENT

A. In the event the Contractor encounters at the site material reasonably believed to be asbestos which has not been abated, the Contractor shall immediately stop work in the area affected and report the condition to the Owner. If in fact the material is asbestos and the asbestos has not been abated, the Contractor shall not resume the non-asbestos-related work in the affected area until the asbestos has been abated. The abatement action may be done in two ways, as the Owner may decide. The Owner may perform the abatement by its own forces, or the Owner may contract with a third party to perform the abatement.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SPACE REQUIREMENTS

A. General:

1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearances for adjustment, repair or replacement.

B. Clearance:

1. Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department.

C. Responsibility:

1. Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

D. Review:

1. Final arrangements of equipment to be installed shall be subject to the Architect/Engineer's review.

E. Equipment, Spaces and Clearances:

- 1. All equipment and accessories shall be new and standard models of a type that has been in satisfactory use for two (2) years. All major components of any given system shall be of the same manufacturer and shall have a manufacturer's nameplate stating address, catalog model number and capacity.
- F. Materials and equipment shall be installed in accordance with manufacturers' recommendations and best standard practice for the type of work involved.
- G. All equipment shall be continuously protected, using temporary shelters, etc., from dirt, dust, moisture, damage, etc., and will not be accepted otherwise. All necessary supports, frames and foundations shall be provided for all equipment.
- H. The responsibility for the furnishing of the proper plumbing equipment rests entirely upon the Contractor who shall request advice and supervisory assistance from the representatives of specific manufacturers during the installation.
- It shall be the responsibility of the Contractor that the combination of proposed equipment will
 fit into the allotted space shown on the plan with adequate clearances for maintenance and
 servicing.

J. Any apparatus, which is too large to permit access through stairways, doorways, shaft, etc., shall be delivered to the job and set in place prior to constructing the plumbing room enclosures.

K. Machinery Drive:

- 1. For motor, and other power-driven equipment specified in plumbing work sections, the following shall apply:
 - Couplings: Where couplings are specified for direct drive, use all-steel flexible type, Falk Corp. "Type F Steelflex," Farrel-Birmingham Co. Inc., "Gearflex," or approved equal.
 - b. Belt Drive: Where V-belt drive is specified, design for overload as per manufacturer's recommendation for type of service intended but in any case not less than 125 percent of motor horsepower rating, of dimensions and number of belts to transmit required power with 95 percent minimum efficiency; use machined cast iron or steel sheaves designed for this type of drive; belts and sheaves shall be of same manufacture; "Gates Rubber Co., "Vulco Ropes & Sheaves," or approved equal.

L. Machinery Accessories:

- Lubricating Devices: Provide oil level gages, grease gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating means are not easily accessible, extend to locations as directed. Furnish all grease gun fittings of uniform type.
- 2. Sleeve Bearings: Where sleeve bearings are specified for equipment, use self-aligning type, Randall Graphite Bearings, Inc., or approved equal.
- 3. Belt Guards: Provide guards to enclose belt, pulleys and sheaves on belt-driven equipment. Construct of galvanized expanded or perforated sheet steel, or 1-inch mesh wire screen, in angle frame with steel angle or channel mounting supports; make guard easily removable for access to belt, pulley or sheave. Conform to codes or regulation of agencies having jurisdiction. Paint prime and finish coats as directed.
- 4. Guard Railing: Where guard railings are required for machinery hazard protection, provide galvanized pipe railing with special railing fittings, galvanized malleable iron, Grinnell Co., Inc., Fig. 1181, or approved equal; fasten, brace as directed. Where required provide suitable hinged and latched gate. Conform to codes or regulations of agencies having jurisdiction. Paint prime and finish coats as directed.
- 5. Equipment Supports, Foundations, Stands: Where supports, foundations, stands, suspended platforms for machinery, tanks or vessels, and other equipment are indicated or specified in plumbing work sections, perform as follows:
 - a. Design, Construction, Location
 - Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.
 - 2) Conform to applicable technical societies' standards, also to codes and regulations of agencies having jurisdiction.
 - 3) Locate supports for vessels to avoid undue strain on shell and interference with pipe connections to vessel outlets.
 - 4) For vessels containing tubes, check support locations for clearance to pull tubes.
 - 5) Where saddles are indicated or specified for vessel supports, use cast iron or welded-steel saddles of curvature to fit vessel.
 - 6) Mount power-driven equipment on common base with driver unless otherwise indicated, specified or approved.
 - 7) Submit detailed shop drawings of all supports; obtain approval before fabricating or constructing.

M. Access Doors:

1. Furnish and locate for installation under General Construction, access doors for concealed expansion joints, valves, traps, strainers, cleanouts, other parts requiring accessibility for operation and maintenance.

- 2. In suspended tile ceilings, use tile in place of access door; provide in such tile a button or other means for identification and easy removal when necessary.
- 3. Access door size shall be as indicated and where not indicated, make 12" x 12" minimum, or larger as directed. For acoustical ceilings, conform to Architect/Engineer panel pattern.
- 4. Unless otherwise indicated, access doors shall be hinged flush type steel framed panel, 12 gage minimum for door, 14 gage minimum for frame, with anchor straps; only narrow border shall be exposed, preferably only thickness of frame. For tile walls, provide stainless steel access doors.
- 5. Hinges shall be concealed type; locking devices shall be flush cam type, screwdriver operated. Access doors and frames shall have prime coat of rust inhibiting paint.

3.02 RELATED ELECTRICAL PROVISIONS

- A. Electrical Contractor To Provide:
 - 1. Line Voltage and hook-up to all Plumbing (Division 22) Equipment
- B. Plumbing Contractor to Provide:
 - 1. All motor starters (with heaters as required).
 - 2. All Plumbing Equipment.
 - 3. All relays, contactors, and switches required to start/stop Plumbing Equipment other than switches shown on and required by Division 26.
- C. The Electrical plans are based on the equipment and devices scheduled shown on the drawings or as called for in the specifications. Should any plumbing equipment or device associated devices be changed or accepted from those which are shown or noted, all electrical and/or plumbing changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Engineer or their representatives.
- D. All conduit and boxes for thermostats and/or sensors shall be provided by electrical contractor.
- E. General:
 - 1. All electrical equipment, control components and circuits not specifically covered herein shall conform to the requirements in Division 26, Electrical.
- F. Motor driven equipment and its installation shall be provided complete with motors, wiring, motor starters, interlocks, and operating and/or safety controls. Their electrical characteristics shall conform to that indicated. Motor starters shall be provided complete with properly sized thermal-overload protection in all phases and other appurtenances necessary for motor control. Motors shall be of adequate size to drive equipment at specified capacity without exceeding nameplate rating of the motor.
- G. Such items as electric control, motors, relays, thermostats, terminal or limiting switches on equipment, etc., shall be furnished as part of the equipment involved. All of these electrical controls, interlocks, and devices shall be installed and wired into the system to conform to Division 26. They shall be complete with all required conduit, condulets, boxes, wire, grounds, power disconnect switches, etc. The electrical trades doing Division 26 work shall provide all power wiring of 115 volt or higher including interlocks. All control wiring shall be the responsibility of the plumbing trades, who shall furnish all wiring and diagrams.
- H. Motors:
 - 1. Except where otherwise specified or indicated for motors in plumbing and electrical work sections, the following shall govern:
 - a. Motors 1/2 horsepower and smaller shall be single phase, 115 volt;
 3/4 horsepower and larger shall be three phase; exceptions will be made, as approved, in case of fractional horsepower motor-driven equipment units furnished by manufacturer with integral motor to suit this standard design.
 - b. Single-phase motors shall be capacitor-start, split-phase or shaded- pole type, as approved for individual application.

- I. Polyphase motors shall be squirrel-cage induction, or wound-rotor induction type, of NEMA Design B, according to starting torque and current characteristics, as approved for individual application. Motors with variable frequency drives shall have insulation rated for that service.
- J. Where motor type, horsepower, speed, or other essential data are not specified in detailed specification of individual equipment unit or indicated on schedules, obtain this information from manufacturer of equipment unit and have it approved before ordering motors.

K. Manufacture:

 Motors furnished under plumbing and electrical work shall not be the product of more than two manufacturers. Exceptions will be made as approved, in cases of fractional horsepower motor, or when motor is furnished integral with driven equipment unit as manufacturer's standard.

L. Design, Performance:

- 1. NEMA standards shall be taken as minimum requirements for motor design and performance, except where otherwise specified.
- M. Motors shall be suitable for load, duty, voltage, frequency and hazard, for service and location intended.
- N. NEMA classification of motor enclosures shall apply when motor types are specified as open, drip proof, splash proof, totally enclosed and the like.
- O. Motors shall have ball or roller type bearings with pressure grease lubrication; exceptions will be made, as approved, in special cases for sleeve type bearings with approved method of oil lubrication.
- P. Motors shall be guiet operating.
- Q. Motors shall be rated for continuous duty and under full load; maximum rise in temperature shall not exceed current standards.
- R. Motors shall be capable of withstanding momentary overloads of 50 percent, without injurious overheating.
- S. Motors for belt drive shall have adjustable bases with set screws to maintain belt tension; motors for direct drive with coupling shall be doweled to base plate at two points.
- T. Motors shall have nameplates giving manufacturer's name, shop number, horsepower, rpm, and current characteristics.

U. Motor Tests:

- 1. For motors 75 horsepower or smaller, check tests against complete tests of similar motor will be accepted; for motors over 75 horsepower, make complete test for each motor furnished and submit certified test data sheets for approval.
- 2. Test for following:
 - Determine motor load performance in accordance with ANSI Standard C-50, for insulation resistance, dielectric strength, efficiency, and power factor and temperature rise.
 - b. Determine efficiency and power factor for 50 percent, 75 percent and 100 percent of rated horsepower; for motors 100 horsepower and larger, include also 125 percent rating.
 - c. Perform temperature-rise test at rated horsepower for rated time interval or until temperature becomes constant.

V. Motor Starters:

- 1. System Description
 - a. Single Phase Starter: Starters for 115VAC single phase motors less than 1 HP shall be capable of both manual and automatic operation. Refer to Section V.2 for single phase starter requirements.

- b. Combination Starters: Provide combination magnetic starters for all motors requiring branch circuit protection or a line-of-sight disconnect. Refer to Section W.3 for combination magnetic starter requirements.
- 2. Enclosed Full Voltage Non-Reversing (FVNR) Single Phase Starter
 - a. Single Phase Motor Starter Control: The single phase motor starter shall consist of a manually operated quick-make toggle mechanism lockable in the "Off" position which shall also function as the motor disconnect. Additionally, the starter shall provide thermal overload protection, run status pilot light and fault pilot light. The starter must include the capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output and fault output. All control terminals shall be integrated in the starter. At a minimum, each single phase starter shall include an interposing run relay and current sensing status output relay. Single phase motor starter shall be in a surface mount enclosure.
 - b. Approved manufacturer: Franklin Control Systems.
- 3. Enclosed Full Voltage Non-Reversing (FVNR) Combination Starter.
 - Magnetic Motor Starters with disconnects shall be enclosed in a general purpose electrical enclosure with the appropriate environmental rating. NEMA 1 for indoor installation and NEMA 3R for outdoor installation
 - b. Starters shall consist of a horsepower rated magnetic contactor with a minimum of 2NO and 2NC auxiliary contacts and solid state electronic overload relay.
 - c. Overload relay shall protect all three phases with a wide range 1-40 amp current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable.
 - d. Overload relay shall incorporate SmartStart Technology, or the following protective functions:
 - 1) Out of calibration protection (if the FLA on the overload is set outside acceptable range, overload will trip to indicate fault event)
 - 2) Stall protection
 - 3) Max time to start
 - 4) Locked Rotor
 - 5) Phase Unbalance
 - 6) Phase loss
 - 7) Cycle Fault
 - e. Starter shall be field selectable for manual or auto reset to restore normal operation after a trip or fault condition. Manual pushbutton shall be accessible without removing or opening cover on starter.
 - f. In the event of a power failure, starter shall restart in last mode by default. Starter shall also be capable of restart with 10 second delay, or restart in "off" mode.
 - g. All starters must be provided with a universal power supply capable of a 208 to 600 volt input range. The power supply must accept the available line voltage and the control voltage shall not exceed 24V.
 - h. Installed accessories shall include Hand-Off-Auto operation pushbutton keypad. Include LED pilot light indicators for Hand, Off, Auto, Run and Overload conditions.
 - The starter shall include remote run terminals which accept both a voltage input signal and a contact closure. The voltage run input shall accept both AC and DC signals from 12-250V to allow direct connection of the transistorized automation signal to the starter.
 - Starter must contain an integral current sensor with NO contact which closes to indicate motor run status as well as a NO contact which closes when an overload trip condition occurs.
 - k. The starter must provide a voltage output to operate the actuator to open the damper or valve without closing the motor circuit. The starter will only close the motor circuit and start the motor after it has received a contact closure from a limit or end switch confirming the damper or valve position.

- I. The starter shall include a dedicated voltage input for Fireman's Override operation. When activated, the starter run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman's Override input is to act as a smoke purge function. Fireman's Override has priority over the Emergency Shutdown input.
- m. The starter shall include an Emergency Shutdown input which will disable the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.
- n. Manufacturer shall provide and install tags with engraved white lettering to designate equipment served
- o. All disconnects shall include a lock-out mechanism when in the off position.
- p. Motor circuit protectors (MCP) shall be provided as the acceptable form of disconnecting means. The MCP shall be a UL listed 508 current limiting manual motor starter with magnetic trip elements only. The MCP shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides a minimum interrupting rating of 30,000 AIC for the combination starter.
- q. Approved manufacturer: Franklin Control Systems or Engineer approved equal.

W. Motor Control Enclosure for individual Motor:

 Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

X. Automatic Alternating Devices:

- 1. Where alternating devices are specified for duplex pumping units, furnish device, which will automatically alternate the cycle of operation.
- 2. Automatic alternator shall be Square D Co., Class 9039 in separate enclosure, or in common enclosure with specified starter and disconnect means, Class 8541, or approved equal.
- 3. Mechanical alternator for duplex unit with common tank shall be Square D Co., Class 9038 or approved equal.

Y. Alarm Audible Signal Device:

- 1. Where alarm bell or gong is specified, furnish 4 inch, 6 inch or 10 -inch heavy duty vibrating bell, for 24-volt or 115 volt alternating current; Edwards Co., "Adaptable" No. 340, or approved equal.
- 2. Where size is not specified, furnish 10-inch sized for boiler room, 6-inch or 4-inch in other locations as approved.
- Z. For outdoor installation, mount bell in weatherproof box Edwards Co., No. 348 or 349.

AA. Motor Control Enclosure for individual Motor:

 Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

BB. Cleaning Piping, and Equipment:

1. Piping and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances. Should any pipe, or other part of the systems be stopped by any foreign matter, disconnect, clean and reconnect wherever necessary for purpose of locating and removing obstructions. Repair work damaged in the course of removing obstructions.

3.03 EXCAVATION, BACKFILLING, AND CUTTING

A. Boring, excavating, backfilling and cutting shall not be undertaken without receiving approval of the Architect/Engineer before starting same. Cutting through masonry on concrete shall be

made with masonry saws or core drills. This approval is required where the work may interfere with the work of other trades or where it may weaken the structure in any way.

B. Excavation:

1. All excavation of every description and of whatever substances encountered, to the depth indicated on the drawings and/or required for the installation of piping, utility system, etc., shall be performed. All exterior lines shall be installed with a minimum cover of 24 inches unless otherwise indicated. Concrete encase all sewer lines under streets with less than 30 inches of cover. Generally, more cover shall be provided if grade will permit. All excavated materials not required for backfill or fill shall be removed and wasted as acceptable to the Architect/Engineer. All grading in the vicinity of excavations shall be controlled to prevent surface ground water from flowing into the excavation. During excavation, material suitable for backfilling shall be stacked in an orderly manner sufficient distance back from edges of trenches to avoid overloading and prevent slide or cave-ins. Any water accumulated in the excavations shall be removed by pumping or other approved method. All shoring and sheeting required to perform and protect the excavations and to safeguard employees shall be performed. Excavate as required under the building in order that all piping, ductwork, etc. shall clear the ground a minimum of 12 inches for a distance of 24 inches on either side. Edges of such excavation shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Architect/Engineer. The bottom of such excavation shall be graded to drain in a manner acceptable to the Architect/Engineer.

C. Backfilling:

1. The trenches shall not be backfilled until all required tests are performed and until the piping, conduits, utilities systems, etc., as installed, conform to the specified requirements. The trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from larger clods of earth or stone, deposited in thoroughly and carefully rammed 6 inch layers, until the pipe has a cover of not less than 1 foot. The remainder of the material shall be backfilled after moistening and then tamped in place using 1-foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, be refilled and mounded over and smoothed off. Unless otherwise indicated open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that entire depth of trench shall be backfilled in 6 inch lavers, each laver moistened and compacted to a density at least equal to that of the adjacent level in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value, so that paving of the area can proceed immediately after backfilling is completed. Where an area has been prepared for pavement prior to excavation, backfill shall be of such materials and installed as to comply with the paving requirements for preparation of subgrade and stabilized base courses as specified in other sections of the specifications. Along all other portions of the trenches, the ground shall be graded to a reasonable uniformity and the mounding over the trenches left in a uniform and neat condition. Backfill under concrete slab on fill shall be as specified above, shall be select fill, or shall be such other materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.

D. Opening and Closing Pavement and Lawns:

1. Where excavation requires the opening of existing walks, streets, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled, paved areas shall be reinstalled to match existing paving and lawn areas shall be re-sodded.

3.04 CONCRETE WORK

- A. Where concrete work is indicated or specified under plumbing work, as for foundations, piers, pedestals, tank encasement, cradles or saddles for tanks or pipes, manholes, pits, and catch basins, perform as follows:
 - 1. Concrete Strength:
 - a. Concrete shall have compressive strength after 28 days of 2,200 pounds per square inch minimum.
 - b. Concrete mix shall consist of one part Portland cement to 4-1/2 parts by volume of fine and coarse aggregate in dry state, with 7-1/2 gallons water maximum per sack of cement.
 - c. Portland cement shall be as per ASTM C 150, Type 1.
 - d. Concrete aggregate shall be as per ASTM C 33.
 - e. Water shall be clear, of quality suitable for domestic consumption.

3.05 Tests

- A. Following requirements are supplementary to tests specified for individual equipment or systems in plumbing work sections.
- B. Notice of Tests:
 - 1. Give written notice in ample time to all concerned of date when tests will be conducted.
- C. Prior Tests
 - Concealed or insulated work shall remain uncovered until required tests have been completed, but if construction schedule requires it, arrange for prior tests on parts of system as approved.
- D. Preliminary Tests:
 - 1. As soon as conditions permit, conduct preliminary or "turn-over" test of certain equipment as directed, to ascertain compliance with specified requirements. Make needed changes, adjustments or replacements as preliminary tests may indicate, prior to acceptance test.
- E. Acceptance Tests:
 - Conduct pressure, performance and operating tests as specified for each system or
 equipment unit, in presence of Architect/Engineer or other accredited representative of
 Owner, as well as representatives of agencies having jurisdiction. The Contractor shall
 correct all deficiencies resulting from test data and from deficiencies identified at times of
 site observations.
- F. Costs:
 - 1. Furnish labor, material, and instruments and bear other costs in connection with all tests.
- G. Record Report Copies:
 - 1. Provide a copy of all test reports in Operations and Maintenance manual.

3.06 Guarantees

A. All work, including plumbing, equipment, and materials, shall be guaranteed by the Contractor for a period of one (1) year after final acceptance of the work. All defects in labor and materials occurring during the one year after final acceptance of the work shall be immediately repaired or replaced by the Contractor at no additional cost to the owner.

3.07 Certification

A. Certification shall be furnished by the authorized manufacturer's representative stating equipment is installed in accordance with the manufacturer's recommendation and is eligible for specified warranties. Include in Operations and Maintenance manual.

3.08 Operating Instructions

- A. The Contractor shall turn over the following to the Owner at completion of contract.
 - 1. Operating instructions together with wiring diagrams.

- 2. Approved drawings, equipment submittals, as-built control diagrams, etc.
- 3. All equipment guarantees and warranties together with instructions shipped with equipment.
- 4. Parts list of all major items of equipment.
- 5. Test reports.
- 6. All above items shall be "punched" and bound in a loose-leaf notebook.

END OF SECTION 22 05 00

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Pipe markers.
 - Ceiling tacks.
- B. Related Sections:
 - 1. Section 09 90 00 Painting and Coating: Execution requirements for painting specified by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 Scheme for the Identification of Piping Systems.
- B. National Fire Protection Association:
 - 1. NFPA 99.

1.03 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- Shop Drawings: Submit list of wording, symbols, letter size, and color coding for plumbing identification.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

Convene minimum one week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 NAMEPLATES

- A. Product Description:
 - Laminated three-layer plastic with engraved white letters on black contrasting background color.

2.02 PIPE MARKERS

- A. Color and Lettering:
 - 1. Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers:
 - 1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Provide continuous banding tape with directional arrows around circumference at each end of markers.

2..03 CEILING TACKS

- C. Description:
 - Steel with 3/4 inch diameter color-coded head.
- D. Color code as follows:
 - 1. HVAC equipment: Yellow.
 - 2. Fire dampers/smoke dampers: Red.
 - 3. Plumbing valves: Green.
 - 4. Cooling valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- D. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates.
- E. Identify control panels and major control components outside panels with plastic nameplates.
- F. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Stenciled identification is not acceptable for identifying any piping or equipment.
- H. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 22 05 53

SECTION 22 0700

PLUMBING INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plumbing piping insulation, jackets and accessories.
- B. Related Sections:
 - 1. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Section 09 90 00 Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.02 REFERENCES

- A. ASTM International:
 - ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement.
 - 4. ASTM C449/C449M Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 6. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 7. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
 - 8. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 9. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 10. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 11. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - 12. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - 13. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 14. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 15. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.

1.03 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Samples: Submit two samples of representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Maintain one copy of each document on site.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Furnish five year manufacturer warranty for manmade fiber.

PART 2 PRODUCTS

2.01 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - Jacket Temperature Limit: minus 20 to 150 degrees F

- B. TYPE P-2: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
 - Thermal Conductivity: 0.27 at 75 degrees F
 - 2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

2.02 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
 - ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
 - 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
- B. PVC Plastic Pipe Jacket:
 - 1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
 - 2. Thickness: 10 mil
 - 3. Connections: Brush on welding adhesive. Pressure sensitive color matching vinyl tape.
- C. Aluminum Pipe Jacket:
 - 1. ASTM B209.
 - 2. Thickness: 0.020 inch thick sheet.
 - Finish: Smooth.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 6. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum. 0.020 inch thick stainless steel.

2.03 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield.
 MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self adhesive closure. Thickness to match pipe insulation.
- F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify piping has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Hot Piping Systems less than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- E. Hot Piping Systems greater than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Insulate flanges and unions at equipment.
- F. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- G. Insulation Terminating Points:
 - 1. Condensate Piping: Insulate entire piping system and components to prevent condensation within the building envelope.
- H. Closed Cell Elastomeric Insulation:
 - 1. Push insulation on to piping.
 - 2. Miter joints at elbows.
 - 3. Seal seams and butt joints with manufacturer's recommended adhesive.

- 4. When application requires multiple layers, apply with joints staggered.
- 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- I. Insulated pipe exposed in janitor rooms or finished spaces: Finish with aluminum jacket.
- J. Insulated Piping Exterior to Building:
 - Insulate fittings, joints, and valves with insulation of like material and thickness as
 adjoining pipe, and finish with glass mesh reinforced vapor retarder cement.
 Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side
 of horizontal piping with overlap facing down to shed water or on bottom side of
 horizontal piping.

3.03 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Domestic Hot Water Supply and Recirculation	P-1	1-1/4 inches and smaller	1.0
		1-1/2 inches and larger	1.5
Domestic Cold Water	P-1 or P-2	1-1/4 inches and smaller	0.5
		1-1/2 inches and larger	1.0

B. Drainage Services Piping within Plenum Insulation Schedule:

	ENCLOSURE REQUIREMENTS		
PVC PIPING SYSTEMS	PVC piping serving any system located within return air plenums shall be encapsulated in a listed and labeled ASTM E 84, NFPA 262 and ASTM E 136 fire barrier plenum wrap designed and rated for such use. Wrap shall be equal to 3M Fire Barrier Plenum Wrap 5A+ or equal.		

END OF SECTION 22 07 00

SECTION 22 1100

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - Domestic water piping, within 5 feet of building.
 - 2. Domestic water piping, above grade.
 - 3. Unions and flanges.
 - 4. Valves.
 - 5. Pipe hangers and supports.
 - Pressure gages.
 - 7. Pressure gage taps.
 - 8. Thermometers.
 - 9. Water pressure reducing valves.
 - 10. Relief valves.
 - Strainers.
 - 12. Hose bibs.
 - 13. Hydrants.
 - 14. Recessed valve boxes.
 - Backflow preventers.
 - 16. Water hammer arrestors.
 - Diaphragm-type compression tanks.
 - In-line circulator pumps.

1.02 REFERENCES

- A. American National Standards Institute:
 - ANSI Z21.22 Relief Valves for Hot Water Supply Systems.
- B. American Society of Mechanical Engineers:
 - ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B40.1 Gauges Pressure Indicating Dial Type Elastic Element.
 - 4. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.
- C. American Society of Sanitary Engineering:
 - ASSE 1010 Performance Requirements for Water Hammer Arresters.
 - ASSE 1011 Performance Requirements for Hose Connection Vacuum Breakers.
 - ASSE 1013 Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
 - 4. ASSE 1019 Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.

5. ASSE 5013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).

D. ASTM International:

- 1. ASTM B32 Standard Specification for Solder Metal.
- 2. ASTM B88 Standard Specification for Seamless Copper Water Tube.
- 3. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- 4. ASTM D2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 5. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- 6. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- 7. ASTM E1 Standard Specification for ASTM Thermometers.

E. American Welding Society:

- 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 67 Butterfly Valves.
 - 3. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 4. MSS SP 80 Bronze Gate, Globe, Angle and Check Valves.
 - 5. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
 - 6. MSS SP 110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
 - Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 - 5. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Certificate:
 - Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Project Record Documents:
 - 1. Record actual locations of valves and equipment.

- C. Operation and Maintenance Data:
 - Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.05 QUALITY ASSURANCE

- A. For drinking water service, provide valves complying with NSF 61, lead-free.
- B. Lead Free: All wetted surface of pipe, fittings and fixtures in potable systems shall have a weighted average lead content equal to or less than 0.25% per Safe Drinking Water Act as amended January, 4, 2014.
 - 1. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable water service. Values for domestic water must be third party certified.
- C. All pipe fittings shall be domestically manufactured (Foreign pipe will not be acceptable).

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum ten years experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

A. Furnish one packing kit for each size valve, and two loose keys for outside hose bibs.

PART 2 - PRODUCTS

2.01 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- Copper Tubing: ASTM B88, Type L, annealed.
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection or Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.02 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder.

2.03 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

- 1. Copper Piping: Class 150, bronze unions with soldered.
- 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - Copper Piping: Class 150, slip-on bronze flanges.
 - 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.04 BALL VALVES

- A. Manufacturers:
 - 1. NIBCO, Inc.
 - Watts.
 - Engineer approved equal.
- B. 2 inches and Smaller: MSS SP 110, 400 psi WOG two piece silicon bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle or extended lever handle for insulated pipe systems.

2.05 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America.
 - Milwaukee Valve Company.
 - NIBCO, Inc.
 - Stockham Valves & Fittings.
 - 5. Engineer approved equal.
- B. 2 inches and Larger: MSS SP 67, Class 150, Class 200, Class 250.
 - Body: Cast or ductile iron, lug or grooved ends, stainless steel stem extended neck.
 - 2. Disc: Nickel-plated ductile iron.
 - Seat: Resilient replaceable EPDM.
 - 4. Handle and Operator: 10 position lever handle.

2.06 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - Manufacturers:
 - NIBCO, Inc.
 - b. Watts.
 - c. Engineer approved equal.
 - 2. 2 inches and Smaller: MSS SP 80, Class 150, silicon bronze body and cap, silicon bronze seat, Buna-N disc, solder or threaded ends.

2.07 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - B-Line.
 - 2. Grinnell.
 - 3. Holdrite.
 - Engineer approved equal.
- B. Plumbing Piping:
 - 1. Conform to MSS SP 58, MSS SP 69 and MSS SP 89.
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch:

- Malleable iron, adjustable swivel, split ring.
- D. Hangers for Cold Pipe Sizes 2 inches and Larger:
 - 1. Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe, Sizes 2 to 4 inches:
 - Carbon steel, adjustable, clevis.
- F. Multiple or Trapeze Hangers:
 - 1. Steel channels with welded supports or spacers and hanger rods.
- G. Vertical Support:
 - 1. Steel riser clamp.
- H. Copper Pipe Support:
 - Carbon steel ring, adjustable, copper plate.
- I. Commercial Pipe Support for Plumbing Chase/Individual Rough-In Installation:
 - The following system is for piping rough-in support to a bank of fixtures or for an individual fixture rough-in, the item or items to be used are as manufactured by Hubbard Enterprises, 393 Enterprise Street, San Marcos, CA 92078, Phone Number (760) 744-6944. Local representation is by Steve Mechler and Associates, Inc. at 10737 Gulfdale, San Antonio, TX 78216, Phone Number (210) 545-0084.
- J. Fine Arts Building Special Requirements:
 - Piping located within this facility shall be supported by noise dampening clamping systems at all locations. Noise dampening clamping systems shall be equal to the Holdrite Silencer System or approved equal.
- K. Support of the aforementioned piping installations shall be by means of the listed engineered methods rather than by use of scrap materials or other "make-shift" means.

2.08 PRESSURE GAUGES

- A. Manufacturers:
 - Trerice.
 - Weksler.
 - Weiss.
 - 4. Engineer approved equal.
- B. Gage: ASME B40.1, UL 393 UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Cast aluminum.
 - 2. Bourdon Tube: Brass.
 - 3. Dial Size: 2 inch diameter.
 - 4. Mid-Scale Accuracy: Two percent.
 - Scale: PSI.

2.09 PRESSURE GAGE TAPS

- A. Ball Valve:
 - 1. Brass 1/4 inch NPT for 250 psi.
- B. Pulsation Damper:
 - Pressure snubber, brass with 1/4 inch NPT connections.

2.10 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - Trerice.

- 2. Weksler.
- Weiss.
- Engineer approved equal.
- B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: Brass, 3/4 inch NPT, 3-1/2 inch (89 mm) long.
 - 4. Accuracy: 2 percent.
 - Calibration: Degrees F.

2.11 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - Armstrong.
 - 2. Taco.
 - Watts.
 - Engineer approved equal.
- B. 2 inches and Larger: MSS SP 85, brass body, bronze fitted, elastomeric diaphragm and seat disc, flanged. 200 psi maximum inlet pressure and adjustable from 25 to 75 psi outlet pressure.

2.12 RELIEF VALVES

- A. Manufacturers:
 - Armstrong.
 - 2. Taco.
 - Watts.
 - Engineer approved equal.
- B. Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- C. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.13 STRAINERS

- A. Manufacturers:
 - 1. NIBCO, Inc.
 - Bell & Gossett.
 - 3. Taco.
 - Engineer approved equal.
- B. 2 inch and Smaller: Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.

2.14 HOSE BIBS

A. Manufacturers:

- 1. Mifab.
- 2. Watts.
- 3. Zurn.
- 4. Engineer approved equal.
- B. Interior:
 - 1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel, integral vacuum breaker in conformance with ASSE 1011.

2.15 HYDRANTS

- A. Manufacturers:
 - 1. Mifab.
 - 2. Watts.
 - 3. Zurn.
 - 4. Engineer approved equal.
- B. Wall Hydrant:
 - 1. ASSE 1019; non-freeze, self-draining type with chrome plated lockable recessed box hose thread spout, hand wheel and integral vacuum breaker.

2.16 RECESSED VALVE BOXES

- A. Refrigerator:
 - Plastic preformed rough-in box with brass valves, wheel handle, slip in style with finished cover.

2.17 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers:
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.18 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Mifab.
 - 2. Watts.
 - Engineer approved equal.
- B. ASSE 1010; stainless steel construction, bellows type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 34 to 250 degrees F and maximum 250 psi working pressure.

2.19 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - Armstrong.
 - Bell & Gossett.
 - 3. Elbi.
 - 4. Taco.
 - Engineer approved equal.

B. Construction:

 Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories:

1. Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.20 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

- Armstrong.
- 2. Bell & Gossett.
- Grundfos.
- 4. Taco.
- Engineer approved equal.
- B. Casing: Bronze rated for 125 psig working pressure with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two, oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against stationary ceramic seat.
- F. Drive: Flexible coupling.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- Remove scale and dirt, on inside and outside, before assembly.

3.03 INSTALLATION - THERMOMETERS AND GAGES

- A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- Install gage taps in piping.
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.04 INSTALLATION - HANGERS AND SUPPORTS

A. Inserts:

- 1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

- B. Pipe Hangers and Supports:
 - Install in accordance with MSS SP 89.
 - 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- C. Fine Arts Building Special Requirements:
 - 1. Piping located within this facility shall be supported by noise dampening clamping systems at all locations. Noise dampening clamping systems shall be equal to the Holdrite Silencer System.

3.05 INSTALLATION - ABOVE GROUND PIPING

- Install non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

Provide access where valves and fittings are not accessible.

- H. Install domestic water piping in accordance with ASME B31.9.
- I. Sleeve pipes passing through partitions, walls and floors.
- J. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- K. Install unions downstream of valves and at equipment or apparatus connections.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- N. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- O. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- P. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- Q. Provide spring loaded check valves on discharge of water pumps.
- R. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- S. Test backflow preventers in accordance with ASSE 5013.
- T. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to toilets, urinals and showers and other fixtures as required by code.

- U. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures. Fabricate same size as supply pipe or 3/4 inch minimum and minimum 18 inches long.
- V. Install mechanical sleeve seals, sleeves, escutcheons and grout in accordance with Section 22 05 00.

3.06 INSTALLATION - PUMPS

A. Install in-line circulator pumps in accordance with manufacturer's requirements.

3.07 MAXIMUM PRESSURE

- A. Provide pressure reducing valves on domestic water systems where pressures exceed 70 psi. Provide a minimum downstream pressure of 60 psi. Contractor shall obtain pressure readings at building cold water supply connection and forward pressure test findings to the Architect in written letter form prior to start of construction of interior water supply piping.
- B. Pressure reducing valves shall be located exposed in mechanical rooms or (where space permits) above ceilings or in walls, with access doors of adequate size.
- C. Equip all pressure reducing valves with two ball valves (for shut-off), a strainer, a pressure relief valve and two pressure gages. Relief valve discharge shall be routed to a safe point of discharge outside of building.

3.08 INSTALLATION - SERVICE CONNECTIONS

A. Provide new water service complete with pressure reducing valve, and strainer.

3.09 FIELD QUALITY CONTROL

B. Test domestic water piping system in accordance with Section 22 05 00.

3.10 CLEANING

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- D. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION 22 11 00

SECTION 22 1300

FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sanitary sewer piping buried within 5 feet of building.
 - 2. Sanitary sewer piping above grade.
 - Floor drains and floor sinks.
 - 4. Cleanouts.
 - Roof drains.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - ASTM D2729 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 3. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.

1.03 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
 - 2. Sanitary and Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
- C. Manufacturer's Installation Instructions:
 - 1. Submit installation instructions for material and equipment.

1.04 CLOSEOUT SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Project Record Documents:
 - 1. Record actual locations of equipment and clean-outs.

1.05 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years experience.

B. Installer:

- 1. Company specializing in performing Work of this section with minimum five years experience.
- 2. All work shall be performed by or under the supervision of a master plumber licensed by the State of Texas.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 SANITARY SEWER, VENT PIPING AND GREASE WASTEBURIED WITHIN 5 FEET OF BUILDING

- A. PVC Pipe:
 - ASTM D2665, polyvinyl chloride (PVC) material, bell and spigot solvent sealed ends.
 - 2. Fittings: PVC, ASTM D2665.
 - Joints: ASTM D2855, solvent weld with ASTM F656 purple primer and D2564 solvent cement.

2.02 SANITARY SEWER, GREASE WASTE, AND VENT PIPING, ABOVE GRADE

- A. PVC Pipe:
 - 1. ASTM D2665, polyvinyl chloride (PVC) material.
 - 2. Fittings: ASTM D2665, PVC.
 - 3. Joints: ASTM D2855, solvent weld with ASTM F656 purple primer and ASTM D2564 solvent cement.

2.03 CHEMICAL RESISTANT SEWER PIPING

- A. Polypropylene Pipe.
 - 1. Fittings: Polypropylene
 - 2. Joints: No hub, (mechanical clamps).

2.04 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. B-Line.
 - 2. Grinnell.
 - Holdrite.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Drain, Waste, and Vent:
 - 1. Conform to MSS SP 58, MSS SP 69 and MSS SP 89.
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch:
 - 1. Malleable iron, adjustable swivel, split ring.
- D. Hangers for Pipe Sizes 2 inches and Larger:
 - 1. Carbon steel, adjustable, clevis.
- E. Multiple or Trapeze Hangers:
 - Steel channels with welded spacers and hanger rods.

- F. Vertical Support:
 - 1. Steel riser clamp.

2.05 FLOOR DRAINS AND FLOOR SINKS

- A. Manufacturers:
 - Mifab.
 - 2. Wade.
 - 3. Zurn.
 - Engineer approved equal.
- B. See schedules on drawings for further information.

2.06 CLEANOUTS

- A. Manufacturers:
 - Mifab.
 - Wade.
 - 3. Zurn.
 - Engineer approved equal.
- B. See schedules on drawings for floor and wall cleanout requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 22 05 00 – Common Work Results for Plumbing.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Inserts:
 - 1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- B. Pipe Hangers and Supports:
 - 1. Install in accordance with MSS SP 89.
 - 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

3.04 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot (2 percent) minimum. Maintain gradients.

- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- F. Install piping to maintain headroom. Do not spread piping, conserve space.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- J. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Install bell and spigot pipe with bell end upstream.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. Install rated plenum wrap on all PVC piping exposed to the return air plenum. See Section 22 07 00 for requirements.

3.05 FIELD QUALITY CONTROL

A. Test sanitary waste and vent piping system in accordance with Section International Plumbing code.

END OF SECTION 22 13 00

SECTION 22 3300

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Commercial electric water heaters.
- B. Related Sections:
 - 1. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
- B. American Society of Mechanical Engineers:
 - ASME PTC 25 Pressure Relief Devices.
 - 2. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.

1.03 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data:
 - 1. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.

1.04 CLOSEOUT SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Operation and Maintenance Data:
 - Submit replacement part numbers and availability.

1.05 QUALITY ASSURANCE

- A. Conform to ASME Section VIII for construction of water heaters.
- B. Water Heater Performance Requirements:
 - 1. Equipment efficiency not less than prescribed by ASHRAE 90.1.

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years experience.
 - 2. All work shall be performed or supervised by a Master Plumber licensed in the State of Texas.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept water heaters on site in original labeled cartons. Inspect for damage.

B. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 COMMERCIAL ELECTRIC WATER HEATERS

- A. Manufacturers:
 - 1. A. O. Smith
 - 2. Rheem.
 - Chronomite
 - 4. Rinnai
 - 5. Engineer approved equal.
- B. Type:
 - 1. Factory-assembled and wired, electric, vertical storage.
 - 2. Maximum working pressure: 150 psig.
- C. Tank:
 - 1. Glass lined welded steel; thermally insulated with minimum 2 inches glass fiber insulation encased in corrosion-resistant steel jacket; baked-on enamel finish.
- D. Controls:
 - 1. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
- E. Accessories:
 - 1. Brass water connections and dip tube drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heaters as indicated on drawings.
- C. Connect piping to supply and return water heater connections.
- D. Install shut off valves on inlet and outlet of water heater.
- E. Install discharge piping from relief valves and drain valves to nearest floor drain.

END OF SECTION 22 33 00

SECTION 22 4000

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Protective devices.
 - 2. Water closets.
 - Urinals.
 - 4. Lavatories.
 - 5. Sinks.
 - 6. Mop sinks.
 - 7. Electric drinking fountains.
 - 8. Fixture carriers.
 - 9. Lavatory insulation kits.

1.02 SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Product Data:
 - Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Certificate:
 - Certify products meet or exceed specified requirements.

1.03 CLOSEOUT SUBMITTALS

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Operation and Maintenance Data:
 - 1. Submit fixture, trim, exploded view and replacement parts lists.

1.04 QUALITY ASSURANCE

- A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
- B. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.

1.05 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Installer:
 - Company specializing in performing Work of this section with minimum five years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 - PRODUCTS

2.01 GENERAL

A. Plumbing fixture types, manufacturer, style and other pertinent information is provided on the drawings. Alternate manufacturers from those identified on the drawings will be considered by the Engineer for approval.

2.02 PROTECTIVE DEVICES

- A. Approved backflow preventers shall be used to connect piping to plumbing fixtures or equipment that do not have an approved integral device for cross connection protection.
- B. Reduced Pressure Principle Type:
 - 1. Furnish a Watts Number U-909-S-HW-QT Reduced Pressure Principle backflow preventer. Equip complete with bronze strainer, stainless steel check modules, guarter turn ball valves and integral body unions.
 - 2. For each backflow preventer valve, furnish a Watts 909-AG Fixed Air Gap fitting with inlet compatible with outlet of backflow preventer relief valve opening. Furnish a full size drain line from air gap fitting to floor drain or hub drain.

2.03 CHROME FINISH

A. All exposed fixture trim, including (but not limited to) p-trap, supplies, riser supports, flex tube risers, etc. shall have a polished chrome finish. Furnish all polished chrome finished nipples, extension pieces, escutcheons, etc. required to meet this requirement.

2.04 ACCEPTABLE MANUFACTURES

- A. Plumbing Fixtures:
 - Acorn
 - 2. American Standard
 - 3. Bradley
 - 4. Crane
 - Guardian
 - 6. Kohler
 - 7. Sloan
 - 8. Zurn
- B. Trim:
 - American Standard
 - 2. Bradley
 - 3. Chicago Faucet
 - 4. Elkay
 - 5. Kohler
 - 6. McGuire
 - 7. Speakman
 - 8. Symmons
 - 9. T&S Brass
 - 10. Watersaver
 - 11. Sloan
- C. Water Closet Seats:
 - 1. Bemis
 - 2. Beneke
 - 3. Church
 - 4. Zurn
 - 5. Kohler
 - 6. American Standard
- D. Mop Sinks:
 - 1. Stern-Williams

- 2. Zurn
- Fiat
- 4. Acorn
- E. Drinking Fountains:
 - 1. Elkay
 - 2. Halsey Taylor
 - Haws
 - 4. Oasis
 - 5. Sunroc.
- F. Flush Valves:
 - Sloan
 - 2. Zurn
 - 3. Delany
- G. Point-of-Use Thermostatic Mixing Valves:
 - 1. Leonard
 - 2. Powers
 - 3. Symmons.
- H. Carriers:
 - 1. Zurn
 - 2. Watts
 - Josam
 - 4. Mifab
 - 5. Wade
 - 6. JR Smith

2.05 LAVATORY INSULATION KIT

- A. Manufacturers:
 - 1. McGuire Manufacturing, Inc.
 - 2. Truebro.
 - 3. Engineer approved equal.
- B. Product Description:
 - 1. Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white, for insulating tailpiece, P-trap, valves and supply piping. Furnish with weep hole and angle valve access covers.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 22 05 00 Common Work Results for Plumbing.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- G. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 0500

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders in addition to the requirements of Division One specifications govern work under this section and all of Division 23.
- B. This section is in particular reference to and shall be considered a part of all Mechanical specifications sections following. It is intended that comments in this section be applicable to all parts of Division 23. Work described hereinafter shall be included as though written within each specific section of the specification.
- C. The Contractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on the Drawings and/or herein, including all labor, materials, equipment, and incidentals necessary and required for their completion.
- D. All work shall conform to requirements of all local construction codes, applicable sections of the National Fire Protection Association, and the Public Health Agency.

1.02 SCOPE

- A. Requirements specified in this section shall govern applicable portions of all mechanical sections including paragraphs on related electrical work, whether so stated therein or not.
- B. Where items specified in the specific mechanical sections conflict with requirements in this section, the specific sections shall govern.
- C. The Contractor shall furnish all labor, plant, equipment, and materials, complete in connection with the installation of the heating, air conditioning, ventilating, controls, utilities and systems in strict accordance with this specification and accompanying plans. The Contractor shall submit his bid based on performing all work hereinafter specified or indicated on applicable plans. The Contractor shall furnish and install all connections and appurtenances necessary and usually furnished in connection with such work and systems even though not specifically mentioned or shown on the plans.
- D. These requirements cover information, work, equipment and accessories listed under the following headings:
 - 1. References, Definitions, Procedures
 - 2. Permits and Fees
 - 3. Utility Connections and Inspections
 - 4. Workmanship
 - 5. Plumbing Provisions
 - 6. Mechanical Provisions
 - 7. Electrical Provisions
- E. Work of Other Sections:
 - 1. Requirements given within this Section apply to the Work of all Sections of this Division.
- F. Finish painting is specified in other Divisions. Prime and protective painting shall be provided under this Division.
- G. Electrical interlock apparatus and other electrical apparatus, which is not an integral part of equipment specified under this Division, are specified under Division 26. Necessary conduit, wiring, boxes, and fittings are specified under Division 26.

1.03 REFERENCES

- A. References to standards, codes, specifications and recommendations shall mean the latest edition of such publications adopted and published at date of invitation to submit Proposals.
- B. References to technical societies, trade organizations and governmental agencies is made in mechanical work sections in accordance with the following abbreviations:

1.	AFI	Air Filter Institute
2.	AGA	American Gas Association
3.	AIEE	American Institute of Electrical Engineers
4.	ANSI	American National Standards Institute
5.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
6.	ASME	American Society of Mechanical Engineers
7.	ASTM	American Society for Testing and Materials
8.	AWWA American Water Works Association	
9.	CMA	Convector Manufactures Association
10.	CSD	Commodity Standards Division U.S. Department of Commerce
11.	HPACCNA	Heating, Piping & Air Conditioning Contractors National Association
12.	IBR	Institute of Boiler & Radiator Manufacturers
13.	IUHA	Industrial Unit Heater Association
14.	NAFM	National Association of Fan Manufacturers
15.	NFPA	National Fire Protection Association
16.	NBS	National Bureau of Standards
17.	NEC	National Electrical Code (NFPA Pamphlet No. 70)
18.	NEMA	National Electrical Manufactures Association
19.	SBI	Steel Boiler Institute
20.	UL	Underwriters' Laboratories, Inc.

1.04 DEFINITIONS

- A. Definitions of terms and expressions used in mechanical work are:
 - 1. "Provide" shall mean "furnish and install" or "furnish labor and material required for installation of."
 - 2. "Herein" shall mean the contents of a particular section where this term appears.
 - 3. "Indicated" shall mean "indicated on contract drawings."
 - 4. "Section" shall mean one of the portions of mechanical work sections indexed in Division 23.
 - 5. "Concealed" where used in connection with insulation and painting of piping, ducts and accessories, shall mean that they are hidden from sight as in trenches, chases, furred spaces, pipe shafts or hung ceilings.
 - 6. "Exposed" where used in connection with insulation and painting of piping, ducts, and accessories shall mean that they are not "concealed" as defined herein above.
 - 7. "Piping" includes in addition to pipe, also fittings, valves, hangers and other accessories, which comprise a system.
- B. Drawings and Instructions

1. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, fixtures, ducts, interlocks, piping and approximate sizes and locations of equipment and outlets. Mechanical trades shall follow these drawings in laying out their work, consult other trades and general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify and coordinate spaces in which their work will be installed. The contract drawings shall be considered as a part of these specifications. It is intended that any Contractor making proposal to execute any work should study the drawings for his own particular trade, as well as all drawings of all other trades in order to fully understand the work he is expected to perform. As a qualification for bidding, the contractor shall visit the site and be responsible for determining all existing conditions in as far as it affects his work prior to submitting a proposal.

1.05 DRAWINGS

A. General:

The Drawings are schematic in nature and indicate approximate locations of the heating, ventilating, air conditioning systems, and piping systems, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the building. Locate all items by on-the-job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Location:

1. Prior to locating diffusers and grilles, obtain the Architect/Engineer's approval as to exact location. Locations shall not be determined by scaling drawings. Contractor shall be responsible for costs of redoing work of trades necessitated by failure to comply with this requirement.

1.06 DISCREPANCIES

A. Clarification:

1. Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Contractor Agreement:

- Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.
- C. The drawings intend that all equipment and piping be arranged as shown with necessary minor rearrangements to suit the equipment approved and to comply with the requirements of the various equipment manufacturers' recommendations. Some minor rearrangements are expected to best fit the structural conditions. It shall be the responsibility of the Contractor to make known his desires in such change, by shop drawings as required, to obtain agreement of the Architect/Engineer before proceeding with any change or variation. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner or Architect/Engineer.

1.07 SUBMITTALS - GENERAL

- A. Submittal Procedures: See TPWD UGC/Special conditions, for submittal requirements in addition to the following:
 - 1. Submittal Preparation:

- a. Minimum of six (6) copies are required, complete (all items submitted at one time), index to each Section of Specifications and include the following information and action taken.
 - 1) Project Name
 - 2) Date
 - Name and Address of Architect
 - Name and Address of Engineer
 - Name, Address and Telephone Number of Contractor and Subcontractors.
 - 6) Name, Address and Telephone number of major equipment manufacturer's local representatives.
 - 7) Manufacturer's Name
 - 8) Published ratings or capacity data
 - 9) Detailed equipment drawing for fabricated items
 - 10) Wiring diagrams
 - 11) Installation instructions
 - 12) Other pertinent data
 - 13) All required submittals and data, bound together, submitted at one time.
- b. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with a highlighter pen, or other means of identification clearly legible.
- c. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such Contractor default shall be allowed.
- B. Submittal Organization:
 - 1. Organize all required data in a 3-ring black (in color) binder of sufficient size with index tabs with number and appropriate title of specification section.
- Provide a cover sheet and an index sheet listing all items submitted.
- D. The second and third sheet shall be blank for stamping of submittals. All submittals are to be processed at same date; partial submittals are not acceptable and will not be reviewed.
- E. Show any revisions to equipment layout required by use of selected equipment. The Engineer shall receive submittals no later than thirty (30) working days from contract date with General Contractor and Owner. Allow two weeks (10 working days) for review process.
- F. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.08 FABRICATION AND SHOP DRAWINGS, DESCRIPTIVE DATA

A. As soon as practical and within thirty days after the official award of contract and before any materials and equipment are purchased, the Contractor shall submit to the

Architect/Engineer, for review, six (6) copies of the complete list of all materials and equipment identified and referenced to specification paragraphs together with applicable fabrication and shop drawings. In addition, the names and addresses of the manufacturers, their catalog data, numbers, and trade names shall be furnished. Published performance data indicating pressure drops, pump curves, balance points, etc., shall be furnished to indicate compliance with scheduled performance. For all fans and pumps, provide the "family" of curves, not just the selected performance point (minimum size 8 ½" x 11"). This data will be marked "Reviewed" by the Engineer, dated and distributed to the several parties involved, with three (3) copies returned to the Contractor. The data shall include the following:

- 1. Equipment-room layouts drawn to ½" scale, including equipment, piping, accessories, to show clearances for operating and servicing.
- 2. Equipment and materials as indicated in each Section.
- Automatic control system and sequence of control together with all data on components. In no case will wire-to-wire or terminal type of wiring diagrams for control system be included or checked as submittal; they shall be included as information only.
- 4. Wiring diagrams, control panelboards, motor test data, motor starters and controls for electrically operated equipment furnished by mechanical trades.
- Composite coordination drawings of crowded locations where there is a
 possibility of conflict among trades. Indicate exact locations and elevations of
 pipes, ducts, and conduits, obtained from field measurements, after consultation
 and agreement among trades involved.
- See also Section 23 31 00.

B. Verification of Dimensions:

- The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall verify all dimensions in the field and advise the Architect/Engineer of any discrepancy before performing the work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or Architect/Engineer.
- C. Equipment other than that shown should be used in bids only when approved by the Engineer prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, electrical work, connections, piping, etc. which shall be paid for by the Contractor. In the event that the Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect/Engineer reserves the right to reject this equipment, and the Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:

1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions. Submit such directions to Architect/Engineer prior to time of installation for use in review of the work.

E. Operating Instructions, Charts:

1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect/Engineer, require such

instructions; see also requirements for owner's manuals at the end of this section.

F. When so specified or instructed, mount operating instructions laminated or in approved frame with glass over; locate where directed.

1.09 GENERAL INSTALLATION

A. Lines and Grades:

- 1. Construct work in conformity with lines and grades as indicated, using axis lines and bench marks provided under General Construction; verify such axis lines and bench marks.
- 2. Axis lines within building will be so spaced on each floor level that mechanical work may be laid out with tape measure having length of 50 feet maximum.
- 3. Bench marks outside building will be at accessible points on building walls, from which lines and grades required for installation of mechanical and electrical work may be set.

B. Existing Services:

- 1. Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect/Engineer.
- Inactive Services: When encountered in work, remove, cap, or plug inactive services.
- 3. Interruption of Services: Where work makes temporary shutdowns of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

C. Objectionable Noise and Vibration:

- 1. Mechanical equipment shall operate without objectionable noise or vibration.
- 2. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building apparatus, piping, ducts or other parts of mechanical work, make necessary changes and additions, as approved, without extra cost to Owner. The completed installation shall result in a noise level below the Noise Criteria Curves from ASHRAE Guide and Data books established for each type of space.

D. Equipment Design and Installation:

- Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purpose shall be the product of same manufacturer.
- Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, AIEE or other applicable technical standards, be suitable for maximum working pressure and shall have neat and finished appearance.
- Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation. Install duct and pipe straight and parallel to building lines, with any required slopes. Install so that connecting and disconnecting of duct, piping and accessories can be made readily, and so that

all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from indicated arrangements may be made, as approved.

E. Protection of Equipment and Materials:

- 1. Responsibility for care and protection of mechanical and electrical work rests with the Contractor until it has been tested and accepted.
- 2. After delivery, before and after installation, protect equipment and materials against theft, injury or damage from all causes.

F. Adjustments:

1. It shall be the responsibility of the Contractor to adjust properly any and all equipment and devices and to run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications. If for some reason any piece of equipment does not function satisfactorily after the first adjustments are made, the Contractor shall continue on the job until satisfactory corrections and adjustments have been made. The Contractor is responsible for the proper performance, functioning, integration, and balance of all equipment. Where tests are required by the Architect/Engineer to ascertain equipment capacities in the installed condition, it shall be the responsibility of the Contractor to run approved tests, to provide all required instruments and apparatus and to submit certified statements of test results. All such instruments shall be in proper calibration and shall meet approval of the Architect/Engineer.

G. Completeness:

- The Contractor shall be responsible for the absolute completeness of his work, including all adjustments and all final balancing to obtain proper operation in all respects. Balancing is in reference to proper airflow and water flow, control calibration, refrigerant flow, or balancing to eliminate objectionable vibrations, noises, or surges.
- 2. Each system is intended to be complete and functional in performance. All such items as piping trim, electrical work, controls, accessories, insulated condensate drains and appurtenances required shall be installed at no extra cost.

1.10 PERMITS AND FEES

- A. All building permits and their required fees, extension of utilities together with applicable meters, and all inspection fees for all mechanical work shall be arranged and paid for by the Mechanical trade involved in the particular work for which the permit is taken, and for the pertinent inspection fee for the work involved by the Contractor.
- B. The Mechanical Contractor shall assist the Owner and Engineer in the application process for any utility rebate that might apply, including scheduling of pre-inspection visits required by the utility, providing information and invoices, and any other requirements.

1.11 WORKMANSHIP

A. All materials and equipment shall be installed in accordance with the approved recommendation of the manufacturer, and workmen skilled in the trade involved shall accomplish the installation.

1.12 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.13 ASBESTOS ABATEMENT

A. In the event the Contractor encounters at the site material reasonably believed to be asbestos which has not been abated, the Contractor shall immediately stop work in the

area affected and report the condition to the Owner. If in fact the material is asbestos and the asbestos has not been abated, the Contractor shall not resume the non-asbestos-related work in the affected area until the asbestos has been abated. The abatement action may be done in two ways, as the Owner may decide. The Owner may perform the abatement by its own forces, or the Owner may contract with a third party to perform the abatement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 SPACE REQUIREMENTS

A. General:

1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearances for adjustment, repair or replacement.

B. Clearance:

 Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department, and manufacturer's requirement.

C. Responsibility:

 Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

D. Review:

 Final arrangements of equipment to be installed shall be subject to the Architect/Engineer's review.

E. Equipment, Spaces and Clearances:

- All equipment and accessories shall be new and standard models of a type that has been in satisfactory use for a minimum of three (3) years. All major components of any given system shall be of the same manufacturer and shall have a manufacturer's nameplate stating address, catalog model number and capacity.
- F. Materials and equipment shall be installed in accordance with manufacturers' recommendations and best standard practice for the type of work involved.
- G. All equipment and materials shall be continuously protected, using temporary shelters, etc., from dirt, dust, moisture, damage, etc., and will not be accepted otherwise. All necessary supports, frames and foundations shall be provided for all equipment.
- H. The responsibility for the furnishing of the proper mechanical and electrical equipment rests entirely upon the Contractor who shall request advice and supervisory assistance from the representatives of specific manufacturers during the installation.
- It shall be the responsibility of the Contractor that the combination of proposed equipment will fit into the allotted space shown on the plan with adequate clearances for maintenance and servicing.
- J. Any apparatus, which is too large to permit access through stairways, doorways, shaft, etc., shall be delivered to the job and set in place prior to constructing the mechanical room enclosures.

K. Machinery Drive:

1. For motor and other power-driven equipment specified in mechanical work sections, the following shall apply:

- a. Couplings: Where couplings are specified for direct drive, use all-steel flexible type, Falk Corp. "Type F Steelflex," Farrel-Birmingham Co. Inc., "Gearflex," or approved equal.
- b. Belt Drive: Where V-belt drive is specified, design for overload as per manufacturer's recommendation for type of service intended but in any case not less than 125 percent of motor horsepower rating, of dimensions and number of belts to transmit required power with 95 percent minimum efficiency; use machined cast iron or steel sheaves designed for this type of drive. Belts and sheaves shall be of same manufacture; "Gates Rubber Co., "Vulco Ropes & Sheaves," or approved equal.

L. Machinery Accessories:

- Lubricating Devices: Provide oil level gages, grease gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating means are not easily accessible, extend to locations as directed. Furnish all grease gun fittings of uniform type.
- 2. Sleeve Bearings: Where sleeve bearings are specified for equipment, use self-aligning type, Randall Graphite Bearings, Inc., or approved equal.
- 3. Belt Guards: Provide guards to enclose belt, pulleys and sheaves on belt-driven equipment. Construct of galvanized expanded or perforated sheet steel, or 1-inch mesh wire screen, in angle frame with steel angle or channel mounting supports; make guard easily removable for access to belt, pulley or sheave and allow for tachometer. Conform to codes or regulation of agencies having jurisdiction. Paint prime and finish coats as directed.
- 4. Guard Railing: Where guard railings are required for machinery hazard or roof edge protection, provide galvanized pipe railing with special railing fittings, galvanized malleable iron, Grinnell Co., Inc., Fig. 1181, or approved equal; fasten, brace as directed. Where required provide suitable hinged and latched gate. Conform to codes or regulations of agencies having jurisdiction. Paint prime and finish coats as directed. (Note that roof mounted equipment has been located a minimum of 10' from the roof edge to preclude requirement for roof edge safety railings. If this distance cannot be met, provide such railing at no additional cost).
- 5. Equipment Supports, Foundations, Stands: Where supports, foundations, stands, suspended platforms for machinery, tanks or vessels, and other equipment are indicated or specified in mechanical work sections, perform as follows:
 - a. Design, Construction, Location
 - Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.
 - 2) Conform to applicable technical societies' standards, also to codes and regulations of agencies having jurisdiction.
 - 3) Locate supports for vessels to avoid undue strain on shell and interference with pipe connections to vessel outlets.
 - 4) For vessels containing tubes, check support locations for clearance to pull tubes.
 - 5) Where saddles are indicated or specified for vessel supports, use cast iron or welded-steel saddles of curvature to fit vessel.
 - 6) Mount power-driven equipment on common base with driver unless otherwise indicated, specified or approved.
 - 7) Submit detailed shop drawings of all supports; obtain approval

before fabricating or constructing.

- M. Smoke Duct Detectors and Shut Down:
 - 1. Fire Alarm Contractor shall furnish and Mechanical Contractor shall install smoke duct detectors in all units providing 2,000 CFM or greater and/or in units serving corridors of egress and/or units having smoke/fire dampers. Interlock with air handler to turn unit off in the event of detection of smoke. Provide and install smoke duct detectors in units smaller than 2,000 CFM if these units supply a contiguous space served by multiple units with a total airflow equal or greater than 2,000 CFM. In this case, provide a smoke duct detector in all units serving this space, regardless of CFM. Comply with the requirements of the authority having jurisdiction.
 - 2. In buildings with existing fire alarm systems, coordinate with fire alarm contractor to install smoke duct detector compatible with fire alarm system. Upon initiation of detections, air handler shall shut down and fire alarm system alarmed.

3.02 RELATED ELECTRICAL PROVISIONS

- A. Electrical Contractor To Provide (coordinate with electrical contractor):
 - 1. Line Voltage and hook-up to all HVAC (Division 23) Equipment
 - 2. All Conduits into accessible attic space for thermostats and sensors.
 - 3. Junction Boxes (Standard Two Gang) required for mechanical and controls contractors, and coordination with mechanical and controls contractors.
 - 4. One TVSS power outlet at each energy management control panel located by project controls contractor.
- B. Mechanical Contractor to Provide:
 - All motor starters (with motor overload protection, including heaters or solid state devices sized for actual motor amperage as required).
 - 2. All thermostats.
 - 3. All HVAC Equipment.
 - 4. All relays, contactors, and switches required to start/stop Mechanical Equipment other than switches shown on electrical drawings and required by Division 26.
- C. Controls Contractor to Provide, or Mechanical Contractor if no Controls Subcontractor:
 - 1. All required relays.
 - 2. All Sensors.
 - 3. All conduit required above ceiling.
 - 4. All control wiring.
- D. The Electrical plans are based on the equipment and devices scheduled shown on the drawings or as called for in the specifications. Should any mechanical equipment or associated devices be changed from those which are shown or noted, all electrical and/or mechanical changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Engineer or their representatives.
- E. All Conduit and boxes for thermostats and/or sensors shall be provided by mechanical contractor. A thermostat or sensor junction box and 3/4" conduit to accessible attic and/or to corridor shall be provided for each room served with HVAC equipment. All control conduits required in attic, clear spaces, or on roof shall be by the Mechanical or Controls Contractor.
- F. General Electrical Coordination:
 - 1. All electrical equipment, control components and circuits not specifically covered herein shall conform to the requirements in Division 26, Electrical.

- 2. Mechanical contractor shall coordinate with Electrical trade to confirm that electrical service, including voltage, phase, overcurrent protection, conductors and terminations are compatible with equipment requirements. Any discrepancies shall be called to the attention of the Engineer during submittals.
- 3. Mechanical contractor shall also coordinate carefully to ensure all electrical starters, disconnects, and accessories are covered appropriately and are correct voltage. Review electrical drawings and equipment wiring schedules.
- G. Motor driven equipment and its installation shall be provided complete with motors, wiring, motor starters, interlocks, and operating and/or safety controls. Their electrical characteristics shall conform to that indicated. Motor starters shall be provided complete with properly sized thermal-overload protection in all phases and other appurtenances necessary for motor control. Motors shall be of adequate size to drive equipment at specified capacity without exceeding nameplate rating of the motor.
- H. Such items as electric control, motors, relays, thermostats, terminal or limiting switches on equipment, etc., shall be furnished as part of the equipment involved. All of these electrical controls, interlocks, and devices shall be installed and wired into the system to conform to Division 26. They shall be complete with all required conduit, condulets, boxes, wire, grounds, power disconnect switches, etc. The electrical trades doing Division 26 work shall provide all power wiring of 115 volt or higher including interlocks. All temperature control wiring shall be the responsibility of the mechanical trades, who shall furnish all wiring and diagrams.

I. Motors:

- 1. Except where otherwise specified or indicated for motors in mechanical and electrical work sections, the following shall govern:
 - a. Motors 1/2 horsepower and smaller shall be single phase, 115 volt; 3/4 horsepower and larger shall be three phase; exceptions will be made, as approved, in case of fractional horsepower motor-driven equipment units furnished by manufacturer with integral motor to suit their standard design.
 - b. Single-phase motors shall be ECM, capacitor-start, split-phase or shaded- pole type, as approved for individual application.
- J. Polyphase motors shall be squirrel-cage induction, or wound-rotor induction type, of NEMA Design B, according to starting torque and current characteristics, as approved for individual application. Motors with variable frequency drives shall have insulation rated for that service.
- K. Where motor type, horsepower, speed, or other essential data are not specified in detailed specification of individual equipment unit or indicated on schedules, obtain this information from manufacturer of equipment unit and have it approved before ordering motors.
- L. Manufacture: Motors furnished under mechanical work shall not be the product of more than two manufacturers. Exceptions will be made as approved, in cases of fractional horsepower motor, or when motor is furnished integral with driven equipment unit as manufacturer's standard.
- M. Design, Performance:
 - 1. NEMA standards shall be taken as minimum requirements for motor design and performance, except where otherwise specified.
- N. Motors shall be suitable for load, duty, voltage, frequency and hazard, for service and location intended.
- O. NEMA classification of motor enclosures shall apply when motor types are specified as open, drip proof, splash proof, totally enclosed and the like.

- P. Motors shall have ball or roller type bearings with pressure grease lubrication; exceptions will be made, as approved, in special cases for sleeve type bearings with approved method of oil lubrication.
- Q. Motors shall be quiet operating.
- R. Motors shall be rated for continuous duty and under full load; maximum rise in temperature shall not exceed current standards.
- S. Motors shall be capable of withstanding momentary overloads of 50 percent, without injurious overheating.
- T. Motors for belt drive shall have adjustable bases with set screws to maintain belt tension; motors for direct drive with coupling shall be doweled to base plate at two points.
- U. Motors shall have nameplates giving manufacturer's name, shop number, horsepower, rpm, and current characteristics.

V. Motor Tests:

 For motors 75 - horsepower or smaller, check tests against complete tests of similar motor will be accepted.

2. Test for following:

- a. Determine motor load performance in accordance with ANSI Standard C-50, for insulation resistance, dielectric strength, efficiency, and power factor and temperature rise.
- b. Determine efficiency and power factor for 50 percent, 75 percent and 100 percent of rated horsepower; for motors 100 horsepower and larger, include also 125 percent rating.
- c. Perform temperature-rise test at rated horsepower for rated time interval or until temperature becomes constant.

W. Motor Starters:

- System Description
 - Single Phase Starter: Starters for 115VAC single phase motors less than 1 HP shall be capable of both manual and automatic operation. Refer to Section W.2 for single phase starter requirements.
 - b. Combination Starters: Provide combination magnetic starters for all motors requiring branch circuit protection or a line-of-sight disconnect. Refer to Section W.3 for combination magnetic starter requirements.
- Enclosed Full Voltage Non-Reversing (FVNR) Single Phase Starter
 - a. Single Phase Motor Starter Control: The single phase motor starter shall consist of a manually operated quick-make toggle mechanism lockable in the "Off" position which shall also function as the motor disconnect. Additionally, the starter shall provide thermal overload protection, run status pilot light and fault pilot light. The starter must include the capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output and fault output. All control terminals shall be integrated in the starter. At a minimum, each single phase starter shall include an interposing run relay and current sensing status output relay. Single phase motor starter shall be in a surface mount enclosure.
 - b. Approved manufacturer: Franklin Control Systems.
- 3. Enclosed Full Voltage Non-Reversing (FVNR) Combination Starter.

- Magnetic Motor Starters with disconnects shall be enclosed in a general purpose electrical enclosure with the appropriate environmental rating. NEMA 1 for indoor installation and NEMA 3R for outdoor installation
- b. Starters shall consist of a horsepower rated magnetic contactor with a minimum of 2NO and 2NC auxiliary contacts and solid state electronic overload relay.
- c. Overload relay shall protect all three phases with a wide range 1-40 amp current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable.
- d. Overload relay shall incorporate SmartStart Technology, or the following protective functions:
 - Out of calibration protection (if the FLA on the overload is set outside acceptable range, overload will trip to indicate fault event)
 - Stall protection
 - 3) Max time to start
 - 4) Locked Rotor
 - 5) Phase Unbalance
 - 6) Phase loss
 - 7) Cycle Fault
- e. Starter shall be field selectable for manual or auto reset to restore normal operation after a trip or fault condition. Manual pushbutton shall be accessible without removing or opening cover on starter.
- f. In the event of a power failure, starter shall restart in last mode by default. Starter shall also be capable of restart with 10 second delay, or restart in "off" mode.
- g. All starters must be provided with a universal power supply capable of a 208 to 600 volt input range. The power supply must accept the available line voltage and the control voltage shall not exceed 24V.
- h. Installed accessories shall include Hand-Off-Auto operation pushbutton keypad. Include LED pilot light indicators for Hand, Off, Auto, Run and Overload conditions.
- i. The starter shall include remote run terminals which accept both a voltage input signal and a contact closure. The voltage run input shall accept both AC and DC signals from 12-250V to allow direct connection of the transistorized automation signal to the starter.
- j. Starter must contain an integral current sensor with NO contact which closes to indicate motor run status as well as a NO contact which closes when an overload trip condition occurs.
- k. The starter must provide a voltage output to operate the actuator to open the damper or valve without closing the motor circuit. The starter will only close the motor circuit and start the motor after it has received a contact closure from a limit or end switch confirming the damper or valve position.
- I. The starter shall include a dedicated voltage input for Fireman's Override operation. When activated, the starter run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman's Override input is to act as a smoke purge function. Fireman's Override has priority over the Emergency Shutdown input.

- m. The starter shall include an Emergency Shutdown input which will disable the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.
- n. Manufacturer shall provide and install tags with engraved white lettering to designate equipment served
- o. All disconnects shall include a lock-out mechanism when in the off position.
- p. Motor circuit protectors (MCP) shall be provided as the acceptable form of disconnecting means. The MCP shall be a UL listed 508 current limiting manual motor starter with magnetic trip elements only. The MCP shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides a minimum interrupting rating of 30,000 AIC for the combination starter.
- q. Approved manufacturer: Franklin Control Systems.
- X. Motor Control Enclosure for individual Motor:
 - Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

3.03 EXCAVATION, BACKFILLING, AND CUTTING

A. Boring, excavating, backfilling and cutting shall not be undertaken without receiving approval of the Architect/Engineer before starting same. Cutting through masonry on concrete shall be made with masonry saws or core drills. This approval is required where the work may interfere with the work of other trades or where it may weaken the structure in any way.

B. Excavation:

All excavation of every description and of whatever substances encountered, to the depth indicated on the drawings and/or required for the installation of piping, utility system, etc., shall be performed. All exterior lines shall be installed with a minimum cover of 24 inches unless otherwise indicated. Concrete encase all sewer lines under streets with less than 30 inches of cover. Generally, more cover shall be provided if grade will permit. All excavated materials not required for backfill or fill shall be removed and wasted as acceptable to the Architect/Engineer. All grading in the vicinity of excavations shall be controlled to prevent surface ground water from flowing into the excavation. During excavation, material suitable for backfilling shall be stacked in an orderly manner sufficient distance back from edges of trenches to avoid overloading and prevent slide or cave-ins. Any water accumulated in the excavations shall be removed by pumping or other approved method. All shoring and sheeting required to perform and protect the excavations and to safeguard employees shall be performed. Excavate as required under the building in order that all piping, ductwork, etc. shall clear the ground a minimum of 12 inches for a distance of 24 inches on either side. Edges of such excavation shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Architect/Engineer. The bottom of such excavation shall be graded to drain in a manner acceptable to the Architect/Engineer.

C. Backfilling:

The trenches shall not be backfilled until all required tests are performed and until the piping, conduits, utilities systems, etc., as installed, conform to the specified requirements. The trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy

clay, sand and gravel, soft shale, or other approved materials free from larger clods of earth or stone, deposited in thoroughly and carefully rammed 6 inches layers, until the pipe has a cover of not less than 1 foot. The remainder of the material shall be backfilled after moistening and then tamped in place using 1foot layers. Blasted rock, broken concrete or payement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, be refilled and mounded over and smoothed off. Unless otherwise indicated open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that entire depth of trench shall be backfilled in 6 inch layers, each layer moistened and compacted to a density at least equal to that of the adjacent level in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing valve, so that paving of the area can proceed immediately after backfilling is completed. Where an area has been prepared for pavement prior to excavation, backfilled shall be of such materials and installed as to comply with the paving requirements for preparation of subgrade and stabilized courses as specified in other sections of the specifications. Along all other portions of the trenches, the ground shall be graded to a reasonable uniformity and the mounding over the trenches left in a uniform and neat condition. Backfill under concrete slab on fill shall be as specified above, shall be select fill, or shall be such other materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.

- D. Opening and Closing Pavement and Lawns:
 - Where excavation requires the opening of existing walks, streets, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled, paved areas shall be reinstalled to match existing paving and lawn areas shall be re-sodded.

3.04 CONCRETE WORK

- A. Where concrete work is indicated or specified under mechanical work, as for foundations, piers, pedestals, tank encasement, cradles or saddles for tanks or pipes, manholes, pits, and catch basins, perform as follows:
 - 1. Concrete Strength:
 - a. Concrete shall have compressive strength after 28 days of 2,200 pounds per square inch minimum.
 - b. Concrete mix shall consist of one part Portland cement to 4-1/2 parts by volume of fine and coarse aggregate in dry state, with 7-1/2 gallons water maximum per sack of cement.
 - c. Portland cement shall be as per ASTM C 150, Type 1.
 - d. Concrete aggregate shall be as per ASTM C 33.
 - e. Water shall be clear, of quality suitable for domestic consumption.

3.05 MISCELLANEOUS

- A. Cleaning Piping, Ducts, Equipment:
 - 1. Piping, ducts, and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances. Should any pipe, duct or other part of the systems be stopped by any foreign matter, disconnect, clean and reconnect wherever necessary for purpose of locating and removing obstructions. Repair work damaged in the course of removing obstructions.

 Provide refrigerant circuit access ports located outdoors with locking-type tamperresistant caps.

3.06 TESTS

- A. Following requirements are supplementary to tests specified for individual equipment or systems in mechanical and electrical work sections.
- B. Notice of Tests:
 - Give written notice in ample time to all concerned of date when tests will be conducted.

C. Prior Tests:

 Concealed or insulated work shall remain uncovered until required tests have been completed, but if construction schedule requires it, arrange for prior tests on parts of system as approved.

D. Preliminary Tests:

 As soon as conditions permit, conduct preliminary or "turn-over" test of certain equipment as directed, to ascertain compliance with specified requirements. Make needed changes, adjustments or replacements as preliminary tests may indicate, prior to acceptance test.

E. Acceptance Tests:

Conduct pressure, performance and operating tests as specified for each system
or equipment unit, in presence of Architect/Engineer or other accredited
representative of Owner, as well as representatives of agencies having
jurisdiction. The Contractor shall correct all deficiencies resulting from test data
and from deficiencies identified at times of site observations.

F. Costs:

1. Furnish labor, material, and instruments and bear other costs in connection with all tests.

3.07 GUARANTEES

- A. All work, including mechanical, equipment, and materials, shall be guaranteed by the Contractor for a period of one (1) year after final acceptance of the work. All defects in labor and materials occurring during the one year after final acceptance of the work shall be immediately repaired or replaced by the Contractor at no additional cost to the Owner.
- B. See also individual sections for further requirements.

3.08 CERTIFICATION

A. Certification shall be furnished by the authorized manufacturer's representative stating equipment is installed in accordance with the manufacturer's recommendation and is eligible for specified warranties.

3.09 OWNERS MANUALS

- A. The Contractor shall turn over the following to the Owner at completion of contract.
 - 1. Operating instructions together with wiring diagrams.
 - 2. Approved drawings, equipment submittals, as-built control diagrams, etc.
 - 3. All equipment guarantees and warranties together with instructions shipped with equipment.
 - 4. Parts list of all major items of equipment.
 - 5. List of all local suppliers with contact information
 - 6. Copy of final Test, Adjust and Balance Report.
 - 7. Certificates of acceptance by local inspection departments having jurisdiction.

- 8. Comply with the requirements of Division One in providing "As-built" Mechanical Drawings in a format acceptable to the Owner. Unless otherwise instructed, provide a clean, marked-up set of prints showing as-installed conditions to the Engineer for processing.
- 9. All above items shall be "punched" and bound in a loose-leaf notebook.

END OF SECTION 23 05 00

SECTION 23 0503

PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Pipe and pipe fittings for the following systems:
 - Condensate drain piping.
- B. Related Sections:
 - 1. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
 - 2. Section 23 07 00 HVAC Insulation: Product requirements for piping insulation for placement by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
- B. ASTM International:
 - 1. ASTM B32 Standard Specification for Solder Metal.
 - 2. ASTM B88 Standard Specification for Seamless Copper Water Tube.
- C. American Welding Society:
 - AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data:
 - 1. Submit data on pipe materials and fittings. Submit manufacturers catalog information.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.05 FIELD MEASUREMENTS

Verify field measurements prior to fabrication.

1.06 COORDINATION

A. Coordinate with refrigerant piping and electrical and mechanical trades.

PART 2 - PRODUCTS

2.01 CONDENSATE DRAIN PIPING

A. Copper Tubing: ASTM B88, Type L, OR DWV.

- 1. Fittings: ASME B16.22, wrought copper.
- 2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.02 INSTALLATION

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls. Coordinate with refrigerant piping, electrical and mechanical trades.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- D. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to fittings.
- E. Provide capped cleanouts at changes of direction and at maximum of 50' on straight runs
- F. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- G. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients.
- H. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- I. Insulate piping where located within the building envelope. Refer to Section 23 07 00.

END OF SECTION 23 05 03

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - Flashing.
 - Sleeves.
 - Mechanical sleeve seals.
 - 6. Formed steel channel.
 - 7. Firestopping relating to HVAC work.
 - 8. Firestopping accessories.
 - 9. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Section 07 90 00 Joint Protection: Product requirements for sealant materials for placement by this section.
 - 3. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
 - 4. Section 23 05 03 Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
 - 5. Section 23 05 48 Vibration Control of HVAC Piping and Equipment: Vibration Isolators.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 Power Piping.
 - ASME B31.5 Refrigeration Piping.
 - 3. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - ASTM E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
 - 3. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- D. FM Global:

- 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
 - WH Certification Listings.

1.03 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E814 to achieve fire ratings of adjacent construction in accordance with UL Design Numbers.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- F. Manufacturer's Installation Instructions:

- 1. Hangers and Supports: Submit special procedures and assembly of components.
- 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.07 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1hour.
 - 2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years experience.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Section 23 05 00 – General Mechanical Requirements.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Refrigerant and Condensate Piping:
 - 1. Conform to MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor/Roof Support: Miro Model 3-RAH or approved equivalent.
 - 9. Copper Pipe Support: Copper-plated carbon-steel ring.
- B. Fine Arts Building Special Requirements:
 - 1. Piping located within this facility shall be supported as follows:
 - a. Pipe Hangers: Same as indicated in 2.1.A but with spring hangers as specified in section 23 05 48.
 - b. Floor Supports: Same as indicated in 2.1.A but support shall be mounted on neoprene pad, full size of support base, as specified in section 23 05 48.

2.02 ACCESSORIES

 Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counter-flashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.04 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.

- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Acrylic.

2.05 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - Thunderline Link-Seal, Inc.
 - 2. Substitutions: As approved by Engineer prior to bid date.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.06 FORMED STEEL CHANNEL

A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.07 FIRESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- B. Color: Dark gray.

2.08 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - Sheet metal.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.01 EXAMINATION

- Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.03 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 89.
- Support horizontal piping as scheduled.
- Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.
- M. Install vibration isolation for piping in the Fine Arts Building. Refer to Section 23 05 48.

3.04 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Manufacturer's curb and or curb adapters as applicable for packaged rooftop units and roof mounted exhaust fans as indicated on drawings. Coordinate installation with Roofing/Envelope drawings and roofing contractor.
- B. Provide 3-1/2" thick concrete housekeeping pads for all equipment located on the building exterior. Pad shall extend 6.0 inches on all sides of equipment.
- C. Install all condensing units on neoprene pads at the Fine Arts Building. Refer to Section 23 05 48.

3.05 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical flashing around ducts and pipes penetrating equipment rooms for sound control.

3.06 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.07 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Fire Rated Surface:
 - Seal opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway or trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

F. Non-Rated Surfaces:

- 1. Seal openings through non-fire rated building members as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
- Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
- 4. Interior partitions: Seal all pipe penetrations at all interior walls. Apply acoustical sealant to both sides of penetration to completely fill annular space between sleeve and wall. Additionally, apply acoustical sealant to both sides of penetration to completely fill annular space between piping and sleeve.

3.08 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.09 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 23 05 29

SECTION 23 0548

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - Vibration Isolators.
- B. Related Sections:
 - 1. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
 - 2. Section 23 33 00 Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
- B. American National Standards Institute:
 - 1. ANSI S1.4 Sound Level Meters.
 - 2. ANSI S1.8 Reference Quantities for Acoustical Levels.
 - 3. ANSI S1.13 Methods for the Measurement of Sound Pressure Levels in Air.
 - ANSI S12.36 Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- C. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 575 Method of Measuring Machinery Sound within Equipment Space.
- D. American Society of Heating, Refrigerating:
 - 1. ASHRAE 68 Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 2. ASHRAE Handbook HVAC Applications.
- E. ASTM International:
 - ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - 3. ASTM E596 Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.
- F. Sheet Metal and Air Conditioning Contractors':
 - SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.03 PERFORMANCE REQUIREMENTS

A. Provide minimum specified static deflection requirements.

1.04 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data:
 - 1. Submit schedule of vibration isolator type with minimum deflection ratings and load at each location.
 - 2. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

- C. Design Data:
 - 1. Provide engineering calculations, referenced to specifications and standards, indicating that maximum room sound levels are not exceeded.
- D. Test Reports:
 - Indicate dynamic insertion loss and noise generation values of silencers.
- E. Manufacturer's Installation Instructions:
 - Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate:
 - 1. Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports:
 - Indicate sound isolation installation is complete and in accordance with instructions.

1.05 CLOSEOUT SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.

1.06 QUALITY ASSURANCE

 Perform Work in accordance with ANSI S1.13 standards and recommendations of ASHRAE 68.

1.07 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years documented experience.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 WARRANTY

A. Section 23 05 00 – General Mechanical Requirements.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. Mason Industries.
 - 2. Amber Booth.
 - Vibration Eliminator Co.
 - Engineer approved equal.
- B. Open Spring Isolators:
 - 1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel

to solid equal to 50% of the rated deflection. Spring isolators shall be equal to Mason Industries Type SLF or approved equal.

2. Color code springs for load carrying capacity.

C. Spring Hangers:

- 1. Color code springs for load carrying capacity.
- 2. Hangers shall consist of rigid steel frames containing minimum 1-1/4" thick rubber elements at the top and a steel spring with general characteristics as the open spring isolators seated in a steel washer reinforced rubber cup on the bottom. The rubber element and the cup shall have molded bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the rubber element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring. Spring hangers shall be equal to Mason Industries Type 30N or approved equal.
- 3. Hangers shall be pre-compressed and locked at the rated deflection by means of a resilient up-stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale.
- 4. Color code springs for load carrying capacity.
- D. Neoprene Pad Isolators:
 - Rubber or neoprene-waffle pads.
 - a. 50 durometer.
 - b. Minimum 3/4 inch thick.
 - c. Maximum loading 45 psi.
 - 2. Configuration: Single layer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.02 INSTALLATION

- A. All vibration isolators must be installed in strict accordance with the manufacturers written instructions and all certified submittal data. Contractor shall coordinate quantity and mounting locations of all vibration isolators with equipment manufacturers.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the Architects/Engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- G. Bring to the Architects/Engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment

selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.

- H. Adjust equipment level.
- I. Install spring hangers without binding.

3.03 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.04 SEE DRAWINGS FOR ADDITIONAL INFORMATION

END OF SECTION 23 05 48

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - Pipe markers.
 - Ceiling tacks.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - ASME A13.1 Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturers catalog literature for each product required.
- C. Shop Drawings:
 - Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Manufacturer's Installation Instructions:
 - Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate:
 - Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.

1.05 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years documented experience.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Product Description:
 - Laminated three-layer plastic with engraved white letters on black contrasting background color.

2.02 PIPE MARKERS

- A. Color and Lettering:
 - Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers:
 - Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Provide continuous banding tape with directional arrows around circumference at each end of markers.

2.03 CEILING TACKS

- A. Description:
 - 1. Steel with 3/4 inch diameter color-coded head.
- B. Color code as follows:
 - HVAC equipment: Yellow.
 - 2. Fire dampers/smoke dampers: Red.
 - 3. Plumbing valves: Green.
 - 4. Cooling valves: Blue.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Identify all automatic controls, motor starters, instruments, and relays with plastic nameplates. Key to control schematic.
- E. Identify condensate and suction refrigerant pipes, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- F. Identify rooftop units, air handling units, vav terminal units, condensing units, fan coils, and fans with nameplates.
- G. Stenciled identification is not acceptable for identifying any piping or equipment.
- H. Provide ceiling tacks to locate VAV terminal units, control panels and dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53

SECTION 23 0593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting and balancing (TAB) of air systems.
 - 2. Testing, adjusting and balancing of refrigerating systems.
 - Measurement of final operating condition of HVAC systems.

1.02 RELATED SECTIONS

1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.03 REFERENCES

- A. Associated Air Balance Council:
 - AABC MN-1 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.04 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Within 60 days of notice to proceed submit firm's name and proposed personnel to be used on the project; provide copies of current NEBB or AABC certificates.
- C. Test Reports:
 - Indicate data on AABC or NEBB Report forms.
- D. Field Reports:
 - 1. Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Submit draft copies of report for review prior to final acceptance of Project. Submit proof of latest calibration date of each instrument, no more than 1 year from date of test.
- F. Furnish reports in 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced (xerox, 11x17) drawings with air outlets and equipment identified to correspond with data sheets, and indicating actual thermostat/sensor locations. (Schematic sketch or diagram will not be acceptable.)

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Furnish final copy of testing, adjusting, and balancing report included in operating and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AABC and NEBB standards.

1.07 QUALIFICATIONS

- A. Acceptable Agencies:
 - 1. Engineered Air Balance Co., Inc.
 - PHI Service Agency, Inc.
 - Professional Test and Balance Services, Inc.
 - Testing Specialties, Inc.
 - 5. Substitutions: As approved by Engineer prior to bid date.
- B. Perform Work under supervision of AABC or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.08 PRE-TEST MEETINGS

- A. Convene minimum one week prior to commencing work of this section. Review procedures to be used, stage of construction required, list of personal and subcontractors required.
- B. Coordinate with General Contractor, Commissioning Authority, Mechanical Contractor, and Controls Contractors to ensure readiness for TAB.

1.09 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in 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. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Service valves are open.

3.02 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during review of testing.

3.03 INSTALLATION TOLERANCES

- A. Air Handling Systems:
 - Adjust to within plus or minus 5 percent of design.
- B. Air Outlets and Inlets:
 - 1. Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 ADJUSTING

- A. Comply with requirements of Division 1 for testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance. (Present on summary page near front of report.)
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner/Engineer using same instruments as during TAB.

3.05 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, outside and exhaust air quantities. Where required, replace sheaves on belt drive fans to meet design airflows at no additional cost to the Owner.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- Measure air quantities at air inlets and outlets.
- Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds via VFD. Vary branch air quantities by damper regulation.
- G. Provide system HVAC floor plans (11x17 fold-out) with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers as a check on leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, outside and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.
- M. For variable air volume units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

3.06 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

- Air Cooled Condensing Units.
- 2. Air Handling Units.
- 3. Fan Coil Units (including mini-split systems).
- 4. Rooftop Units.
- 5. Fans.
- 6. Air Terminal Units.
- 7. Air Inlets and Outlets.

B. Report Forms

- 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date

2. Summary Comments:

- a. Design versus final performance
- Notable characteristics of system
- c. Description of systems operation sequence
- d. Summary of outdoor and exhaust flows to indicate building pressurization
- e. Nomenclature used throughout report
- f. Test conditions

3. Instrument List:

- a. Instrument
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Range
- f. Calibration date

4. Electric Motors:

- a. Manufacturer
- b. Model/Frame
- c. HP/BHP and kW
- d. Phase, voltage, amperage; nameplate, actual, no load
- e. RPM
- f. Service factor

- g. Starter size, rating, heater elements
- h. Sheave Make/Size/Bore
- 5. Air Cooled Condensing Units:
 - a. Identification/number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Serial number
 - f. Entering DB air temperature, design and actual
 - g. Leaving DB air temperature, design and actual
 - h. Number of compressors
- 6. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
- 7. Heating Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air temperature, design and actual
 - g. Leaving air temperature, design and actual
 - h. Air pressure drop, design and actual
- 8. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual

- j. Inlet pressure
- k. Discharge pressure
- I. Fan RPM
- 9. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
- 10. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Fan RPM
- 11. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 12. Airflow Monitoring Station Data:
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Actual velocity

- h. Actual air flow
- 13. Terminal Unit Data:
 - a. Manufacturer
 - b. Type
 - c. Identification/number
 - d. Location
 - e. Model number
 - f. Size
 - g. Minimum static pressure
 - h. Minimum design air flow
 - i. Maximum design air flow
 - j. Minimum actual air flow
 - k. Maximum actual air flow
 - Inlet static pressure
- 14. Air Distribution Test Sheet:
 - a. Air device number
 - b. Room number/location
 - c. Device type
 - d. Device size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow

END OF SECTION 23 05 93

SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - HVAC piping insulation, jackets and accessories.
 - HVAC ductwork insulation, jackets, and accessories.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 4. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 5. ASTM C1071 Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 - ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - 7. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 - 8. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.
 - 9. ASTM E162 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- B. Sheet Metal and Air Conditioning Contractors':
 - SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data:
 - 1. Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions:
 - 1. Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate:
 - Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

- Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Duct insulation, Coverings, and Linings:
 - 1. Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.05 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator:
 - 1. Company specializing in performing Work of this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Manufacturers for Glass Fiber Insulation Products:
 - CertainTeed.
 - Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
 - 5. Engineer approved equal.
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
 - Aeroflex.
 - Aerocell.
 - Armacell, LLC.
 - Armaflex.
 - 5. Nomaco.
 - 6. K-flex.
 - 7. Engineer approved equal.

2.02 PIPE INSULATION

- A. TYPE P-1: ASTM C534, Type I, flexible, nonhalogen, closed-cell elastomeric insulation, tubular.
 - Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Operating Temperature Range: Range: Minus 290 to 250 degrees F.
 - 4. Water Vapor Permeability: 0.08 perm.

2.03 PIPE INSULATION JACKETS

- A. Aluminum Pipe Jacket:
 - ASTM B209.
 - 2. Thickness: 0.016 inch thick sheet.
 - 3. Finish: Embossed.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

2.04 PIPE INSULATION ACCESSORIES

- A. Covering Adhesive Mastic:
 - Compatible with insulation.
- B. Piping 1-1/2 inches diameter and smaller:
 - 1. Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- C. Piping 2 inched and larger:
 - 1. Galvanized steel protection shield (saddle) and insulation insert. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation. High density phenolic or foamglass insert with all service jacket single piece construction with self-adhesive closure. Thickness to match pipe insulation.
- D. Adhesives:
 - 1. Compatible with insulation.

2.05 DUCTWORK INSULATION

- A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.
 - 1. Maximum Thermal Conductivity: 0.29 at 75 degrees F.
 - 2. Maximum Operating Temperature: 250 degrees F.
 - Density: 0.75 pound per cubic foot.
- B. TYPE D-2: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.
 - Maximum Thermal Conductivity: 0.13 at 75 degrees F.
 - 2. Maximum Operating Temperature: 250 degrees F.
 - Maximum Air Velocity: 6,000 feet per minute.

2.06 DUCTWORK INSULATION JACKETS

- A. Vapor Retarder Jacket:
 - Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
 - Secure with vapor retarder lap adhesive.

2.07 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive:
 - Compatible with insulation, equal to Fosters 30 series, with 0.02 perm rating or better, low VOC.
- B. Adhesive:
 - 1. Waterproof, ASTM E162 fire-retardant type.
- C. Liner Fasteners:
 - Galvanized steel, welded with integral head.
- D. Tie Wire:

- 1. 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Impale Anchors:
 - 1. Galvanized steel, 12 gage self-adhesive pad.
- F. Adhesives:
 - 1. Compatible with insulation.
- G. Membrane Adhesives:
 - 1. As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces:
 - Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections and expansion joints.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with vapor retarder adhesive.
- D. Inserts and Shields:
 - 1. Piping 1-1/2 inches diameter and smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- E. Insulation Terminating Points:
 - 1. Condensate Piping: Insulate entire piping system and components within building envelope to prevent condensation.
- F. Closed Cell Elastomeric Insulation:
 - 1. Push insulation on to piping.
 - 2. Miter joints at elbows.
 - 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 - 4. When application requires multiple layers, apply with joints staggered.
 - 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- G. Pipe Exposed in Mechanical Equipment Rooms, Mechanical Platforms, Janitor Rooms or Finished Spaces: Finish with aluminum jacket.
- H. Insulated Piping Exterior to Building:
 - Insulate fittings, joints, and valves with insulation of like material and thickness as
 adjoining pipe, and finish with glass mesh reinforced vapor retarder cement.
 Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side
 of horizontal piping with overlap facing down to shed water or on bottom side of
 horizontal piping.

3.03 INSTALLATION - DUCTWORK SYSTEMS

- A. Duct dimensions indicated on Drawings are finished inside dimensions.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with vapor retarder jacket.
 - Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with standard vapor retarder jacket.
 - Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. External Glass Fiber Duct Insulation:

- Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive to match jacket. The use of pressure sensitive foil tape is unacceptable.
- 2. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
- 3. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive. The use of pressure sensitive foil tape is unacceptable.
- 4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

E. Duct Liner:

- 1. Adhere insulation with adhesive for 100 percent coverage.
- 2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
- 3. Seal and smooth joints. Seal and coat transverse joints.
- 4. Seal liner surface penetrations with adhesive.
- 5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

3.04 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	PIPE DIAMETER inches	INSULATION THICKNESS inches
Condensate Piping from Cooling Coils located within building envelope	P-1	Less than 1-1/2" 1-1/2"- 4"	0.5 1.0
Refrigerant Liquid and Suction	P-1	Less than 1-1/2" 1-1/2"-4"	0.5 1.0

B. Standard Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSTALLED R- VALUE (INSULATION THICKNESS Inches)
Return Ducts	D-2	R-8.0 (2.0)
Return Ducts located outside the building envelope	See 23 31 00	R-8.0
Supply Ducts exposed to ambient conditions (Double Wall Construction)	See 23 31 00	R-8.0
Supply Ducts (externally insulated)	D-1	R-6.0 (2.3)
Supply Ducts Exposed to View (Double Wall Construction)	See 23 31 00	R-6.0
Outside Air/Ventilation Ducts	D-1	R-6.0 (2.3)
Exhaust Ducts Within 10 feet of Exterior	D-1	R-6.0 (2.3)
Supply Ducts Downstream of Variable Air Volume Boxes (externally insulated)	D-1	R-6.0 (2.3)
Transfer Air Ducts (internally insulated)	D-2	R-8.0 (2.0)

C. Acoustically Sensitive Ductwork Insulation Schedule (for Fine Arts Building Ductwork):

C. According Constitute Business in Scientific Confedence	(101 1 III 7 II to Ballaling Backwork).	
DUCTWORK SYSTEM	INSULATION TYPE	INSTALLED R- VALUE (INSULATION THICKNESS Inches)
Return Ducts	D-2	R-8.0 (2.0)
Supply Ducts	D-2	R-8.0 (2.0)
Outside Air/Ventilation Ducts	D-1	R-6.0 (2.3)
Exhaust Ducts Within 10 feet of Exterior	D-1	R-6.0 (2.3)
Supply Ducts Downstream of Variable Air Volume Boxes	D-2	R-8.0 (2.0)
Transfer Air Ducts	D-2	R-8.0 (2.0)

END OF SECTION 23 07 00

SECTION 23 0923

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. ANSI MC85.1 Terminology for Automatic Control.
 - 2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 3. ANSI/ASHRAE Standard 135-2010, BACnet.
 - 4. International Building Code (IBC), including local amendments, IECC and IMC.
 - 5. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 6. National Electrical Code (NEC).
 - 7. FCC Part 15, Subpart J, Class A
 - 8. EMC Directive 89/336/EEC (European CE Mark)
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.
- D. All BAS system components (electronic DDC hardware and all software) shall be of one manufacturer as indicated in manufacturer's trade catalog. Hybrid systems assembled from various manufacturers shall not be acceptable. This requirement does not apply to field devices.
- E. All BAS networks and field devices shall be wired in lieu of wireless. Use of wireless networks and/or field devices shall only be used when expressly approved by the Engineer and only in those locations designated by the Engineer.

1.02 SYSTEM DESCRIPTION

- A. The system shall be a web based Building Automation System (BAS) accessible with standard browsers such as Internet Explorer and Google Chrome. Systems requiring workstation software licenses shall not be acceptable.
- B. General Description:
 - 1. Install the Building Global Controllers in MDF/IDF Rooms or other locations as approved by the Architect/Engineer.
 - 2. The direct digital control (DDC) system shall control equipment as indicated on the drawings.

1.03 WORK INCLUDED

- A. Provide a complete Facility Management and Control System.
- B. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.

- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified and detailed.

1.04 SYSTEM REQUIREMENTS

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be based on ANSI/ASHRAE Standard 135-2010, BACnet. This system is to control all mechanical equipment, including all unitary equipment, all air handlers and any other listed equipment using BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. It shall be the responsibility of the Controls Contractor to coordinate all interface requirements with the respective equipment vendors to provide a complete and working system in all respects.
- C. The Web Server should be designed to harness the power of the Internet and provide efficient integration of standard open protocols (i.e. BACnet). The Network Server creates a powerful network environment with comprehensive database management and messaging services. In addition, the Web Server shall provide an engineering environment and graphical user interface.
- D. The web server shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the web server. It shall be capable of executing application control programs to provide:
- E. Calendar functions
- F. Scheduling
- G. Trending
- H. Alarm monitoring and routing
- I. Time synchronization
- J. Integration of controller data for each applicable protocol
- K. Network Management function for all network devices

- L. All application controllers for every terminal unit (VAV, etc.), and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- M. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.05 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate the following:
 - Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
 - b. Connected data points, including connected control unit and input device.
 - c. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - d. Description and sequence of operation for operating, user, and application software.
 - e. Electrical drawing showing all system internal and external connection points, terminal block layouts and terminal identification.
 - f. Complete bill of materials, valve schedule and damper schedule.
 - g. For all system elements (building controllers) provide BAC net protocol implementation conformance statements (PICS) as per ANSI/ASHRAE Standard 135-2010.
 - h. Provide complete description and documentation of all services and/or objects used in the system
 - i. Manufacturer's Installation Instructions: Submit installation, maintenance, operation instructions for each control system component.
 - j. Use terminology in submittals conforming to ASME MC85.1.
- C. Product Data:
 - 1. Submit data for each system component and software module.
- D. Manufacturer's Installation Instructions:
 - 1. Submit installation instruction for each control system component.
- E. Manufacturer's Certificate:
 - 1. Certify products meet or exceed specified requirements.

1.06 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Project Record Documents:
 - Record actual locations of control components, including control units, thermostats, and sensors.
 - 2. Revise shop drawings to reflect actual installation and operating sequences.
 - 3. Submit data specified in "Submittals" in final "Record Documents" form.
- C. Operation and Maintenance Data:
 - 1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered system components and devices.
 - Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.07 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in manufacturing products specified in this section with minimum five years experience, and with service facilities within 50 miles of Project.

B. Installer:

1. Company specializing in performing Work of this section with minimum three years experience.

1.08 PRE-INSTALLATION MEETINGS

- A. Convene prior to commencing work of this section:
 - 1. Pre-installation meeting.
 - a. Contractor shall attend a pre-installation meeting at the job site with all related contractors and trades on the job. At a minimum the following shall be addressed and coordinated:
 - 1) BAS wiring diagrams, work assignments and trade responsibilities.
 - 2) 120VAC power requirements for any and all locations.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Warrant work against faulty material or workmanship in accordance with Division 01. If the project is occupied or the systems placed in operation in several phases at the request of the Owner's Representative, then the warranty of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation and accepted as such, in writing, by the Owner's Representative. The use of building equipment for temporary service and testing does not constitute the beginning of warranty.
- B. Equipment and material provided under this section shall be periodically inspected and serviced by competent technicians. This function becomes the responsibility of the Owner's Representative when the system is accepted by the Owner's Representative. The one year material and workmanship warranty is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor shall provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct without charge, breakage, maladjustment and other trouble shooting caused by improper maintenance.

1.11 MAINTENANCE SERVICE

- A. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.
- B. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- C. Perform work without removing units from service during building normal occupied hours.
- D. Provide emergency call back service during normal operating hours for this maintenance period.
- E. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- F. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
- G. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.12 RELATED WORK IN OTHER SECTIONS

- A. Refer to Section 23 05 00 for General Mechanical Provisions
- B. Refer to Section 26 05 00 for General Electrical Provisions

1.13 BAS General Requirements

- A. All electrical control wiring shall be furnished and installed under this section, unless shown on the electrical drawings. Low voltage wiring shall be run in EMT conduit in exposed areas and in vertical risers between floors. Low voltage plenum rated wire may be used without conduit in concealed but assessable areas. All conduit on roofs or exteriors shall be rigid with rain tight fittings. Line voltage wiring control wiring shall be run EMT conduit or rigid if outdoors or on roofs.
- B. Space Sensor Installation:
 - Provide conduit stub-ups with junction box in new walls. Wire mold may be used on existing block walls. Provide nylon bushing at the end of all conduit whips for space sensors to prevent chafing of wire.
- C. All 120 volt and higher power wiring associated with the control system shall be provided by Division 26-Electrical. Electrical contractor under the direction of the controls contractor shall provide 120VAC and higher power to all control panels as required. All transformers with secondary voltages of 24 volts or less shall be provided by controls contractor with the exception of the transformers for factory mounted controls such as VAV boxes. In the case of factory mounted controls the manufacturer doing the mounting shall provide control transformers and coordinate the voltages.
- D. All automatic dampers furnished under this section shall be installed by the Mechanical Contractor. It shall be the responsibility of the Mechanical Contractor to provide and install blank off plates when the control application requires dampers smaller than duct size.
- E. All finished painting required for Control piping and equipment shall be done by the General Contractor.
- F. All cutting and patching necessary for the installation of the Control System shall be done by the General Contractor.
- G. Enclosures:
 - 1. Equipment room controllers or relay packs shall not be installed in the room's ceiling. If the equipment is in a mechanical room, electrical room, MDF/IDF room or other dedicated room the associated controller and relays shall be mounted in a NEMA-1 fabricated and hinged metal enclosure with lock within sight of the equipment it controls. Fabricated panel means built in a shop environment with templates and not constructed on site. Extensions to controllers for additional controlled or monitored items for a given area shall be mounted adjacent to the equipment controls.
- H. Space Local Indication:
 - Each IDS (Indicating Digital Space) sensor, where specified, shall display digital readouts
 of temperature and temperature setpoint. The Operator shall be able delete these
 readouts from the Central Workstation on an individual IDS basis as desired.
- I. Local Override Buttons:
 - 1. Shall be integral to the sensor and installed in all areas except common areas such as lobbies, bathrooms, hallways, cafeteria's and auditoriums. Equipment room sensors shall not be equipped with override buttons.
- J. Space Temperature Sensor Local Adjustment:
 - 1. Areas specified to have adjustment shall have a temperature setpoint adjustment that can be limited in software to plus or minus 2 Deg F adjustment range from setpoint.
- K. Air Balance:

- 1. The test and balance contractor shall set the OA damper positions on all units to the scheduled and OA amounts by coordination with the controls contractor.
- L. Actuators:
 - 1. All damper actuators shall be electronic type (Belimo or equal). OA dampers actuators shall be spring return as indicated.
- M. DDC Outputs
 - 1. Separate DDC outputs will be provided for each valve and damper actuator.
- N. DDC Control:
 - 1. All sensors and actuators shall be controlled/monitored by the direct digital control system. Thermostats and humidistats wired to actuators will not be allowed.
- O. Wide Area Network:
 - 1. Connect all networks of points specified above to the owner's network to allow for real time communication. Auto dial up modems are not allowed.

PART 2 PRODUCTS

2.01 DIRECT DIGITAL CONTROLS

- Browser based, open protocol, with all components listed by BTL as BACnet compliant
 - 1. Acceptable manufacturers are:
 - 2. Automated Logic.
- B. Substitutions: None permitted.

2.02 OPERATING SYSTEM SOFTWARE

- A. Input/output Capability From Operator Station:
 - 1. Request display of current values or status.
 - 2. Command selected equipment to specified state.
 - 3. Initiate logs and reports.
 - 4. Change analog limits.
 - 5. Add, delete, or change points within each control unit or application routine.
 - 6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
 - 7. Add new control units to system.
 - 8. Modify and set up maintenance scheduling parameters.
 - 9. Develop, modify, delete or display full range of color graphic displays.
 - 10. Automatically archive select data even when running third party software.
 - 11. Capability to sort and extract data from archived files and to generate custom reports.
 - 12. Support printer operations.
 - 13. Accommodate daylight savings time adjustments.
- B. Operator System Access:
 - 1. Via software password with multiple access levels at work stations and at each control unit
- C. Data Base Creation and Support:
 - 1. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:
 - a. Add and delete points.
 - b. Modify point parameters.
 - c. Change, add, or delete English language descriptors.
 - d. Add, modify, or delete alarm limits.
 - e. Add, modify, or delete points in start/stop programs, trend logs, and other items.
 - f. Create custom relationship between points.
 - g. Create or modify DDC loops and parameters.
 - h. Create or modify override parameters.
 - i. Add, modify, and delete applications programs.
 - j. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:

- 1. Utilizes custom symbols or system supported library of symbols.
- 2. Sixteen (16) colors.
- 3. Real-time live dynamic data for each graphic.
- 4. Dynamic graphic data.

E. Operator Station:

- 1. Accept data from LAN as needed without scanning entire network for updated point data.
- 2. Interrogate LAN for updated point data when requested.
- 3. Allow operator command of devices.
- 4. Allow operator to place specific control units in or out of service.
- 5. Allow parameter editing of control units.
- 6. Store duplicate data base for every control unit and allow down loading while system is on line.
- 7. Control or modify specific programs.
- 8. Develop, store and modify dynamic color graphics.
- 9. Data archiving of assigned points and support overlay graphing of this data

F. Alarm Processing:

- 1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
- Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
- 3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
- 4. Display alarm reports on video. Display multiple alarms in order of occurrence.
- 5. Define time delay for equipment start-up or shut down.
- 6. Allow unique routing of specific alarms.
- 7. Operator specifies when alarm requires acknowledgment.
- 8. Continue to indicate unacknowledged alarms after return to normal.
- 9. Alarm notification:
- 10. Print automatically.
- 11. Display indicating alarm condition.
- 12. Selectable audible alarm indication.

G. Event Processing:

 Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart:

1. Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:

- 1. Automatically display or print user-defined message subsequent to occurrence of selected events.
- 2. Compose, change, or delete message.
- 3. Display or log message at any time.
- 4. Assign any message to event.

J. Reports:

- 1. Manually requested with time and date.
- 2. Long term data archiving to hard disk.
- 3. Automatic directives to download to transportable media for storage.
- 4. Data selection methods to include data base search and manipulation.
- 5. Data extraction with mathematical manipulation.

- 6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
- 7. Generating reports either normally at operator direction, or automatically under workstation direction.
- 8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
- 9. Include capability for statistical data manipulation and extraction.
- 10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore:

 Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:

- 1. Automatically collect and store.
- 2. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display:

- 1. Support graphic development on work station with software features:
 - a. Page linking.
 - b. Generate, store, and retrieve library symbols.
 - c. Single or double height characters.
 - d. Sixty (60) dynamic points of data for each graphic page.
 - e. Pixel level resolution.
 - f. Animated graphics for discrete points.
 - g. Analog bar graphs.
 - h. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:

- 1. Run time monitoring, for each point.
- 2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
- 3. Equipment safety targets.
- 4. Display of maintenance material and estimated labor.
- 5. Target point reset, for each point.

2.03 LOAD CONTROL PROGRAMS

- A. Systems shall be capable of all programs listed; however not all are required by the current sequences of operations.
- B. Demand Limiting:
 - 1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
- C. Duty Cycling:
 - 1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
- D. Automatic Time Scheduling:
 - 1. Self-contained programs for automatic start/stop/scheduling of building loads. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary schedules.
- E. Start/Stop Time Optimization:
 - 1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
 - 2. Adaptive and self-tuning, adjusting to changing conditions.
 - 3. For each point under control, establish and modify:
 - a. Occupancy period.
 - b. Desired temperature at beginning of occupancy period.

c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program:

1. Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points:

1. Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

H. Event Initiated Programming:

1. Any data point capable of initiating event, causing series of controls in a sequence.

I. Direct Digital Control:

Furnish software so operator is capable of customizing control strategies and sequences
of operation by defining appropriate control loop algorithms and choosing optimum loop
parameters.

J. Trend logging:

- 1. Each control unit capable of storing samples of control unit's data points.
- 2. Update file continuously at operator assigned intervals.
- 3. Automatically initiate upload requests and then stores data on hard disk.
- 4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
- 5. Co-ordinate sampling with specified on/off point- state.
- 6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.04 HVAC CONTROL PROGRAMS

A. Optimal Run Time:

1. Control start-up and shutdown times of HVAC equipment for both heating and cooling. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room temperature. Employ adaptive model prediction for how long building takes to warm up or cool down under different conditions.

2.05 PROGRAMMING APPLICATION FEATURES

A. Trend Point:

1. Sample points, real or computed, with each point capable of collecting samples at intervals specified in minutes, hours, days, or month. Output trend logs as line-graphs or bar graphs.

B. Alarm Messages:

- Allow definition of messages, each having sufficient characters for each individual message.
- 2. Assign alarm messages to system messages including point's alarm condition, point's offnormal condition, totaled point's warning limit, hardware elements advisories.
- 3. Output assigned alarm with "message requiring acknowledgment".
- 4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:

- 1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
- 2. Program times for each day of week, for each point, with one minute resolution.
- 3. Automatically generate alarm output for points not responding to command.
- 4. Allow for holidays
- D. Interlocking:

 Permit events to occur, based on changing condition of one or more associated master points.

2.06 BUILDING COMMUNICATIONS CONTROLLER

- A. General Requirements
 - 1. BACnet Conformance:
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet protocol standard.
 - 3. Modules shall be selected to fit the particular project application. Up to seven modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.
 - 4. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
 - 5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
 - 6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
 - 7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
 - 8. Global control algorithms and automated control functions shall execute using 32-bit processor.
 - 9. Schedules
 - a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
 - b. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
 - 10. Logging Capabilities
 - a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.

- b. Logs may be viewed both on-site and off-site using WAN or remote communication.
- c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
- d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

11. Alarm Generation

- a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
- b. Each alarm may be dialed out as noted elsewhere.
- c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
- d. Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

12. Demand Limiting

a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.

2.07 APPLICATION CONTROLLERS

A. Provide one or more native BACnet application controllers as needed for all equipment. All controllers shall interface to building controller via BACnet/IP or BACnet MS/TP. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be system resident. No auxiliary or non-BACnet controllers shall be used.

B. BACnet Conformance

- 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
- 2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermostats, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses. Controller shall also include support and modifiable programming for interface to Intelligent Room Sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.
- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed

by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

E. Application controller shall include support for Intelligent Room Sensor (see Sensors and Miscellaneous Devices section). Display on Intelligent Room Sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor.

2.08 SENSORS AND MISCELLANEOUS DEVICES

- A. Temperature Sensors
 - 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors shall be installed at locations indicated on drawings. Mount 44 inches about finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- B. Wall Sensor (Adjustable)
 - 1. Wall sensor shall use solid-state sensor and shall be packaged in aesthetically pleasing white enclosure. Adjustable sensor shall have a digital LCD screen, be provided with override push button, temperature set point adjustment push buttons and port for plug-in of Field Service Tool for field adjustments. Digital sensor shall be capable of displaying space temperature, space temperature set point, space relative humidity, and CO2 levels. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for space temperature shall also be stored in EEPROM on controller. All programmable variables shall be available via Field Service Tool through wall sensor port. Sensors shall fit neatly over the rough-in box without the need for additional dress plates. Wall sensor shall be equal to Automated Logic M# ZSP-HC-ALC or approved equal.
- C. Wall Sensor (Non-Adjustable)
 - Wall sensor shall use solid-state sensor and shall be packaged in aesthetically pleasing
 white enclosure. Sensors shall fit neatly over the rough-in box without the need for
 additional dress plates. Wall sensor shall be equal to Automated Logic M# ZS-ALC or
 approved equal.
- D. Outside air relative humidity sensor
 - 1. Provide outside air relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
 - a. Non-corroding outdoor shield to minimize wind effects and solar heating. Wall mount weather proof enclosure with conduit fitting.
 - b. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
 - c. ± 2% accuracy (5 95% RH).
 - d. Humidity sensor shall be replaceable.
- E. Wall mounted relative humidity sensor
 - 1. Provide wall mounted relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:

- a. Wall mount enclosure with white cover.
- b. Two wire, 4-20 mA output or digitally communicating proportional to relative humidity range of 0% to 100%.
- c. Humidity sensor shall be replaceable.
- d. ± 2% accuracy (5 95% RH).
- e. Mounted 44 inches above floor.
- F. Duct mounted relative humidity sensor
 - 1. Provide duct mounted relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
 - a. Duct mounted moisture resistant enclosure with conduit fitting.
 - b. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
 - c. Humidity sensor shall be replaceable.
 - d. ± 2% accuracy (5 95% RH).
 - e. 8 inch probe length.
- G. Outside air flow measuring stations (or Engineer approved equal):
 - 1. Ebtron Model GTA116-PC
 - 2. The equipment vendor shall include in its price the cost to attend a pre-installation meeting and shall include the costs to commission its devices certifying proper operation.
- Н. Carbon Dioxide Sensors - Duct Mount
 - 1. Output signal: 4 20ma signal.
 - 2. Accuracy: +/- 30 ppm.

 - Range: 0 2000 ppm.
 Calibration interval: 5 years.
 - 5. Response time: 2 minutes or less.
 - 6. Display: 4 digit LCD.
 - 7. Operating Humidity: 0% to 95% non-condensing.
 - 8. Operating temperature: 32F to 122F.
 - 9. Enclosure: NEMA 1.
- I. Photohelic Differential Pressure Switch and Gauge – Auto Reset – Filter Monitoring
 - 1. Contact Type: Two DPDT
 - 2. Indication: Visible magnehelic pressure indication.
 - 3. Range: Select appropriate range.
 - 4. Accuracy: 2% full scale.
 - 5. Setpoints: Visible.
 - 6. Dial: 4"
- J. Static Pressure Switches - Manual Reset
 - 1. Range: Select appropriate range for anticipated pressures.
 - 2. Duct Static Pressure Tip: Provide tips as required.
 - 3. Contact Type: One DPDT
 - 4. Operating Temperature: -30F to 180F.
 - 5. Reset Type: Manual
- K. Differential Pressure Transmitters - Duct Mount
 - 1. Output Signal: 4 20 ma.
 - 2. Overpressure: 10 psig.
 - 3. Accuracy: 1% full scale.
 - 4. Diaphragm: Stainless steel.
 - 5. Non-Repeatability: 0.1% full scale.
 - 6. Hysteresis: 0.2% full scale.
 - 7. Compensated Temperature Range: 0F to 155F.

2.09 ENCLOSURES

All controllers, power supplies and relays shall be mounted in enclosures.

- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment.
- C. Outdoor enclosures shall be NEMA 3R.
- D. Enclosures shall have hinged, locking doors.
- E. Provide laminated plastic nameplates for all enclosures. Include location and unit served on nameplate. Reference 23 05 53 for nameplate requirements.

2.10 ELECTRONIC ACTUATORS

- A. Execution Details for Actuators and Valves
 - 1. Install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
 - 2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting.
 - 3. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
 - 4. Primary valve control shall be Analog (2-10vdc, 4-20ma).
- B. Actuators for Dampers shall be Electric unless otherwise specified, provide actuators as follows:
 - UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
 - NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
 - 3. 5 year Manufacturer's Warranty. Two-year unconditional + Three year product defect from date of installation.
 - 4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
 - 5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
 - 6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
 - 7. A push button gearbox release shall be provided for all non-spring actuators.
 - 8. Modulating actuators shall be 24Vac and consume 10VA power or less.
 - 9. Conduit connectors are required when specified and when code requires it.

C. Damper Actuators:

- 1. Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- 2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
- 3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
- 4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.

5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

D. Control Dampers.

- 1. The Control Contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment.
- 2. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
- 3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
- 4. Damper linkage hardware shall be constructed of corrosion resistant zinc & nickel-plated steel.
- 5. Frame shall utilize a heavy duty 5in. by 1 in. 13 gauge galvanized steel hat channel frame designed for installation inside the ductwork. Frame shall have reinforced corners and low profile head and sill on dampers less than 17 in high.
- 6. Blades shall be 3-V, single thickness of 16 gauge galvanized steel
- 7. Shafts shall be ½ in. diameter square plated steel axles positively locked to the blades to eliminate slippage between blades and axles. Actuator shaft shall be removable.
- 8. Provide molded synthetic (acetal) bearings in a polished extruded frame raceway.
- 9. Blade-to-blade linkage shall be concealed within the frame
- 10. Provide dampers with flexible metal compression-type jamb seals and extruded vinyl blade seals for low leakage performance. Seals shall be silicone.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify conditioned power supply is available to control units.
- B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units. Implement features of programs to specified requirements and appropriate to sequence of operation.
- C. Install with 120 volts alternating current, 15 amp circuit to each programmable control unit. Controls for life safety equipment shall be on emergency power circuit.
- D. Install conduit and electrical wiring in accordance with requirements of Division 26.
- E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S REPRESENTATIVE FIELD SERVICES

- A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Furnish service technician employed by system installer to instruct Owner's representative in operation of systems plant and equipment.

3.04 DEMONSTRATION AND TRAINING

- A. Furnish basic operator training for multiple persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 8 hours instructor time for onsite training and 8 hours of hands on class environment training.
- B. Demonstrate complete and operating system to Owner, Engineer and Commissioning Authority.

3.05 SEQUENCES OF OPERATION

See drawings for sequences.

3.06 System Graphics - Browser Based Displays

- A. General on all graphics
 - 1. Display time, outside air temperature and outside air humidity on each graphic.
 - 2. Provide navigation links to scheduling, trends, alarms.
 - 3. Provide navigation link to the campus level graphic and building level graphic.
 - 4. Ensure standard operation of backward and forward button on browser.
 - 5. Provide color animation to indicate run status.
- B. Campus Level Graphic
 - 1. Display each building on a geographical map
 - 2. Display time, outside air temperature and outside air humidity.
- C. Building Level Graphic
 - 1. Display equipment on floorplans.
 - 2. Outline each HVAC zone with bold lines.
 - 3. Display thermograph on floorplan (i.e. color shading to represent temperate deviation from setpoint). No exceptions to this requirement will be made.
 - 4. Display if system is following occupied/unoccupied schedule.
- D. Equipment Graphics
 - 1. Display equipment graphic that depicts the actual configuration of the equipment.
 - 2. Display each point value in the appropriate place on the equipment.
 - 3. Provide override capability for output points from equipment graphic.
 - 4. Provide animation to indicate operational points.
 - 5. Provide indication of program outputs such as, but not limited to cooling mode, dehumidification, occupied/unoccupied, etc.
- E. Summary Page Graphics
 - 1. Provide summary list of all mechanical equipment, schedule status, discharge air temperature and discharge air temperature setpoint.
 - 2. Provide summary list of terminal units, schedule status, zone air temperature and zone air temperature setpoint.
 - 3. Provide summary list of all equipment with out of service flags.
 - 4. Provide summary list of all exhaust fans and status.

3.07 Trend Points List

A. Control contractor to start trends on <u>all</u> points during commissioning.

END OF SECTION 23 09 23

SECTION 23 2300

REFRIGERANT PIPING

PART 1 GENERAL

1.01 SCOPE

- A. This section contains specifications for all Refrigerant piping for this project. Included are the following topics:
 - 1. Part 1 General
 - a. Scope
 - b. Related Work
 - c. Reference
 - d. Reference Standards
 - e. Shop Drawings
 - f. Quality Assurance
 - g. Delivery, Storage, and Handling
 - h. Design Criteria
 - 2. Part 2 Products
 - a. Refrigerant Piping
 - 3. Part 3 Execution
 - a. Preparation
 - b. Erection
 - c. Refrigerant Piping
 - d. Construction Verification Items

1.02 RELATED WORK

- A. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 07 00 HVAC Insulation

1.03 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.04 REFERENCE STANDARDS

- A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- B. ASTM B88 Seamless Copper Water Tube
- C. ASTM B280Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- D. ASHRAE 15 Safety Code for Mechanical Refrigeration
- E. ASME B31.5 Refrigeration Piping and Heat Transfer Components
- F. UL 207 Refrigerant-Containing Components and Accessories, Nonelectrical

1.05 SHOP DRAWINGS

A. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

1.06 QUALITY ASSURANCE

A. Order all copper refrigeration tube with each shipping unit marked with the metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored

- marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.08 DESIGN CRITERIA

- A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, Type K hard temper copper tubing may be substituted at Contractor's option.

PART 2 PRODUCTS

2.01 REFRIGERANT PIPING

A. ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove all foreign material from interior and exterior of pipe and fittings.

3.02 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Do not route piping through transformer vaults, elevator equipment rooms, or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment. Coordinate with condensate drain piping, and electrical and mechanical trades. Prepare coordination drawings for field use.

3.03 REFRIGERANT PIPING

- A. Refrigeration piping to be installed by firms who are experienced in installation of such piping.
- B. All joints to be brazed and have a melting point greater than 1,125 degrees F. Filler impurities shall not exceed 0.15%. Tubing to be new and delivered to the job site with the original mill end caps in place. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.

- C. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- D. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.
- E. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
- F. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

END OF SECTION 23 23 00

SECTION 23 3100 HVAC DUCTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Duct Materials.
 - 2. Insulated flexible ducts.
 - 3. Single wall spiral round ducts.
 - 4. Double wall spiral insulated round ducts.
 - 5. Double wall spiral insulated flat oval ducts.
 - 6. Transverse duct connection system.
 - 7. Ductwork fabrication.
 - 8. Duct cleaning.
 - 9. Duct leakage testing.

B. Related Sections:

- 1. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
- 2. Section 23 07 0 HVAC Insulation: Product requirements for duct insulation for placement by this section.
- 3. Section 23 33 00 Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.02 REFERENCES

A. ASTM International:

- 1. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
- 2. ASTM A90/A90M Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- 3. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- 4. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- 5. ASTM A568/A568M Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
- 6. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- 7. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- 8. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 Factory-Made Air Ducts and Connectors.

1.03 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS

- A. Section 23 05 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings:
 - 1. Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - a. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - b. Duct layout, indicating pressure classifications and sizes in plan view.
 - c. Fittings.
 - d. Reinforcing details and spacing.
 - e. Seam and joint construction details.
 - f. Penetrations through fire rated and other walls.
 - g. Terminal unit installations.
 - h. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

1.05 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 Submittal Procedures: Submittal procedures. Project Record Documents:
 - Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA HVAC Duct Construction Standards Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.07 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years documented experience.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealant.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 DUCT MATERIALS

- A. Mastic/Sealants:
 - 1. Manufacturers:

- 2. Hard Cast.
- Johns Manville.
 Fosters/Childers.
- 5. Non-hardening, water resistant, fire resistive, compatible with lining materials, liquid (fully sprayed into joints) or liquid and tape; or heavy mastic.
- Engineer approved equal.
- B. Galvanized Steel Ducts:
 - 1. ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 (Z275) zinc coating of in conformance with ASTM A90/A90M.
- Stainless Steel Ducts: C.
 - 1. ASTM A240/A240M or ASTM A666, Type 304 (for exterior ducts), Type 316L (for fume hood ducts).
- D. Fasteners:
 - 1. Rivets, bolts, or sheet metal screws.
- E. Hanger Rod:
 - 1. ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 INSULATED FLEXIBLE DUCTS

- A. Manufacturers:
 - 1. FlexMaster, Series 1M.
 - 2. Thermaflex, Series M-KE.
 - 3. Engineer approved equal.
- Product Description: UL 181, Class 1 air duct with PE inner film, mechanically locked without B. adhesives to a galvanized spring steel helix, fiber glass insulation; aluminized vapor barrier
 - 1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
 - 2. Maximum Velocity: 4000 fpm.
 - 3. Temperature Range: -10 degrees F to 160 degrees F.

2.03 SINGLE WALL SPIRAL ROUND DUCTS

- Manufacturers: Α.
 - 1. Duct Direct.
 - 2. McGill AirFlow Corporation.
 - 3. Semco Incorporated.
 - 4. Spiral Pipe of Texas.
 - 5. Engineer approved equal.
- B. **Product Description:**
 - 1. UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel. Provide ducts and fittings with paint grip finish.
 - 2. Insulate ducts per specification 23 07 00.

C. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.04 DOUBLE WALL SPIRAL INSULATED ROUND DUCTS

- A. Manufacturers:
 - 1. Duct Direct.
 - 2. McGill AirFlow Corporation.
 - 3. Semco Incorporated.
 - 4. Spiral Pipe of Texas.
 - 5. Engineer approved equal.
- B. Product Description:
 - Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall when located inside the building/stainless steel outer wall when located outside the building, glass fiber insulation (R-6.0 when located inside the building, R-8.0 when located outside the building), perforated galvanized steel inner wall; fittings manufactured with perforated inner wall. Provide ducts and fittings with paint grip finish.

C. Construct spiral duct with the following minimum gages:

Diameter	Gage
3 inches to 14 inches	24
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct round fittings with the following minimum gages:

Diameter	Gage
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20

52 inches to 60 inches	18
62 inches to 84 inches	16

2.05 DOUBLE WALL SPIRAL INSULATED FLAT OVAL DUCTS (RECTANGULAR DOUBLE WALL DUCT IS SIMILAR)

- A. Manufacturers:
 - Duct Direct.
 - 2. McGill AirFlow Corporation.
 - 3. Semco Incorporated.
 - 4. Spiral Pipe of Texas.
 - 5. Engineer approved equal.
- B. Product Description:
 - Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall when located inside the building/stainless steel outer wall when located outside the building, glass fiber insulation (R-6.0 when located inside the building, R-8.0 when located outside the building), perforated galvanized steel inner wall; fittings manufactured with perforated inner wall. Provide ducts and fittings with paint grip finish.

C. Construct flat oval duct with the following minimum gages:

Major Axis Dimension	Gage
7 inches to 24 inches	24
25 inches to 48 inches	22
50 inches to 70 inches	20
72 inches to 82 inches	18
84 inches and larger	16

D. Construct flat oval fittings with the following minimum gages:

Major Axis Fitting Dimension	Gage
7 inches to 36 inches	20
37 inches to 60 inches	18
62 inches and larger	16

2.06 TRANSVERSE DUCT CONNECTION SYSTEM

- A. Manufacturers:
 - 1. Ductmate or equivalent.
- B. Product Description:
 - 1. SMACNA "E" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.07 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- F. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, or mastic plus embedded fabric systems. Tape of any kind is unacceptable for duct sealing.
- G. Sealants and Mastics:
 - 1. Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

- Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards -Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8inch and smaller.
- D. Ductwork exposed to view shall be of either double wall round or double wall flat oval construction unless noted otherwise. See drawings for type and locations. Ducts exposed to view shall be painted per architectural specifications.
- E. Install duct hangers and supports in accordance with SMACNA & ASHRAE standards and as indicated on the drawings.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Connect flexible ducts to metal ducts with stainless steel draw bands.
- H. Exhaust Outlet Locations:
 - 1. Minimum Distance from Property Lines: 3 feet.
 - 2. Minimum Distance from Building Openings: 3 feet.
 - 3. Minimum Distance from Outside Air Intakes: 10 feet.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers to low pressure ducts as indicated on drawings (see details).
- C. Connect air terminal units to supply ducts as indicated on drawings (see details).

3.04 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half.

- Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.05 DUCT LEAKAGE TESTING

- A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
 - 1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Test shall be conducted by Test, Adjust and Balance Contractor. Coordinate and support their efforts.
 - 2. Maximum Allowable Leakage: In accordance with IECC 2012.

3.06 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply/Outside Air	Galv. Steel
Return	Galv. Steel
General Exhaust	Galv. Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Variable Air Volume Supply (downstream of VAV boxes)	1.0 inch w.g. regardless of velocity
Variable Air Volume Supply (upstream of VAV boxes)	3.0 inch wg. regardless of velocity
Constant Volume Supply	2.0 inch w.g. regardless of velocity
Return, Relief and General Exhaust	1.0 inch w.g. regardless of velocity

END OF SECTION 23 31 00

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Duct access doors.
 - 2. Dynamic fire dampers.
 - 3. Volume control dampers.
 - 4. Flexible duct connections.
 - 5. Duct test holes.
- B. Related Sections:
 - Section 23 31 00 HVAC Ducts: Requirements for duct construction and pressure classifications.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- D. Underwriters Laboratories Inc.:
 - 1. UL 555 Standard for Safety for Fire Dampers.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. Fire dampers including locations and ratings.
 - 2. Flexible duct connections.
 - 3. Volume control dampers.
 - 4. Duct access doors.
- E. Product Data: For fire dampers submit the following:
 - Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 - 2. Indicate materials, construction, dimensions, and installation details.
 - Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- F. Manufacturer's Installation Instructions: Submit for Fire Dampers.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of all dampers.

1.05 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 COORDINATION

A. Coordinate Work where appropriate with building control Work.

1.10 WARRANTY

A. Coordinate with General Contractor for product warranties and product bonds.

1.11 EXTRA MATERIALS

A. Furnish two of each size and type of fusible link; turn over to Owner's representative.

PART 2 PRODUCTS

2.01 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, and as indicated on Drawings.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1.0 inch thick insulation with sheet metal cover.
 - 1. Less than 12 inches round, spin-in type, secure with cam locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.02 DYNAMIC FIRE DAMPERS

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Ruskin.
 - 3. Nailor.
 - 4. Substitutions: As approved by Engineer prior to bid date.
- B. Fabricate in accordance with NFPA 90A and UL 555.
- C. Fire Resistance: As required for the barrier.

- D. Dynamic Closure Rating: Dampers classified for dynamic closure to 2000 fpm and 4 inches wg static pressure.
- E. Construction:
 - 1. Integral Sleeve Frame: Minimum 20 gage roll formed galvanized steel. Length: 12 inches.
 - 2. Blades:
 - a. Style: Curtain type.
 - b. Action: Spring closure upon fusible link release.
 - c. Material: Minimum 24 gage roll formed, galvanized steel.
 - 3. Closure Springs: Type 301 stainless steel, constant force type, if required.
- F. Fusible Link Release Temperature: 165 degrees F.
- G. Mounting: Vertical or horizontal as indicated on Drawings.
- H. Duct Transition Connection Damper Style:
 - 1. A style rectangular connection, frame and blades in air stream.
 - 2. B style rectangular connection, blades out of air stream, high free area.
 - 3. G style A style connection, grille mounting tabs at end of sleeve for grille.
 - 4. CR style round connection, sealed.
 - 5. CO style oval connection, sealed.
 - 6. R style round connection, blades in air stream, non-sealed.
 - 7. LR style round connection, blades out of air stream, non-sealed.
 - 8. LO style oval connection, non-sealed.
- Finish: Mill galvanized.

2.03 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.
- C. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.
- D. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers. For inaccessible ceilings, remote operated quadrants shall be Rototwist M# RT-150 operable from face of the air device.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters. Minimum height to be equal to insulation thickness.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
- E. Spin-in Type Duct Tap Fittings:
 - 1. 24 gage G-90 galvanized construction, without scoop, with 2" damper shaft extender and locking quadrant handle.
 - Provide conical taps on branches to air terminal units; straight tap branches to air devices.

2.04 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately 3 inches wide.
 - 3. Metal: 3 inch wide, 24 gage galvanized steel.

2.05 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 23 05 00 General Mechanical Requirements: Coordination and project conditions.
- B. Verify rated walls are ready for fire damper installation.
- C. Verify ducts and equipment installation are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 - 1. Spaced every 50 feet of straight duct.
 - 2. Before each automatic control damper.
 - 3. Before and after each fire damper.
 - 4. Downstream of each VAV box.
- C. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 8 inch for balancing dampers only. Review locations prior to fabrication.
 - Mark access doors for fire dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE DAMPER
- D. Install flexible duct connectors on inlets and outlets of <u>all</u> equipment with moving parts to minimize vibration transmission.
- E. Install permanent duct test holes required for testing and balancing purposes.
- F. Install fire dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
 - 1. Install dampers square and free from racking with blades running horizontally.
 - 2. Do not compress or stretch damper frame into duct or opening.
 - Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
 - 4. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
- G. Install volume control dampers at take-offs to <u>all</u> branch ducts, duct run-outs and at locations required to achieve the supply, return, exhaust, and outside air balance requirements set forth in 23 05 93 and as indicated on the drawings whether dampers are indicated on the drawings or not.

3.03 DEMONSTRATION

A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 3400

HVAC FANS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Ceiling fans.
 - 2. Centrifugal square inline fans.
- B. Related Sections:
 - 1. Section 23 07 00 HVAC Insulation: Product requirements for power ventilators for placement by this section.
 - 2. Section 23 08 00 Commissioning of HVAC: Commissioning requirements.
 - 3. Section 23 09 23 Direct Digital Control System for HVAC: Controls remote from unit.
 - 4. Section 23 31 00 HVAC Ducts: Product requirements for hangers for placement by this section.
 - 5. Section 23 33 00 Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 Standards Handbook.
 - 2. AMCA 204 Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 4. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 5. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 Motors and Generators.
 - 2. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. Underwriters Laboratories Inc.:
 - 1. UL 705 Power Ventilators.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements. Include family of fan curves, not just at operating condition.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams. Also include local manufacturers representative's name, address and phone number/contact information.

1.05 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 or nationally accepted test lab.
- D. Balance Quality: Conform to AMCA 204.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.07 PRE-INSTALLATION COORDINATION

A. Coordinate with General Contractor, Commissioning Agent (CA) and other trades prior to installation of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Product storage and handling requirements.
- B. Protect fans, motors, shafts, bearings and all accessories from weather and construction dust.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Coordinate with General Contractor to provide product warranties and bonds.

PART 2 PRODUCTS

2.01 All fans shall be subject to the performance data indicated on the drawings as well as the construction features and capabilities listed in these specifications. Regardless of a fan manufacturer being listed in the following sections, each fan shall not exceed the listed weight as indicated on the drawings. The equipment vendor/manufacturer shall be fully and solely responsible for any design and/or construction costs required to accommodate larger/heavier fans.

2.02 CEILING FANS

- A. Manufacturers:
 - 1. Greenheck Corp
 - 2. Loren Cook Company
 - 3. Penn Barry
 - 4. Engineer approved equal.
- B. Centrifugal Fan Unit:
 - 1. Direct driven with injection molded resin housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge opening, integral outlet duct collar.

- C. Disconnect Switch:
 - 1. Cord and plug in housing for thermal overload protected motor.
- D. Grille:
 - 1. Aluminum w/baked white enamel finish.
- E. Wheel:
 - 1. Centrifugal forward curved type constructed of injection molded or polypropylene resin.
- F. Motor
 - Open drip proof type with permanently lubricated sealed bearings and thermal overload protection.
- G. Accessories:
 - 1. Wall or roof cap with damper, round duct inlet as applicable.
 - 2. Rubber-in-shear vibration isolators.
 - 3. Fan speed controller.
 - 4. Time delay relay.
- H. Electrical Characteristics and Components:
 - 1. Electrical Characteristics: In accordance with Division 26 specifications and the schedule on drawings.

2.03 CENTRIFUGAL SQUARE INLINE FANS

- A. Manufacturers:
 - 1. Greenheck Corp.
 - 2. Loren Cook Company.
 - 3. Penn Barry.
 - 4. Twin City.
 - 5. Engineer approved equal.
- B. Product Description:
 - 1. Direct drive with galvanized steel housing lined with 1.0 inch acoustical glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collars, and horizontal hanging brackets w/vibration isolators.
- C. Fan Wheel:
 - 1. Backward inclined centrifugal type, aluminum construction.
- D. Motor and Drive Mounting:
 - 1. Out of air stream.
- E. Motor:
 - 1. Open drip proof.
- F. Bearings:
 - 1. ABMA 9 life at 200,000 hours.
- G. Accessories:
 - Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor, NEMA 250 Type 1 enclosure.
 - 2. Fan speed controller, capable of turndown to 50% air flow. Factory installed.
- H. Electrical Characteristics and Components:
 - 1. See Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 23 05 00 – General Mechanical Requirements: Coordination and project conditions.

3.02 INSTALLATION

- A. Install flexible connections specified in Section 23 33 00 between fans and ductwork. Ensure metal bands of connectors are parallel with a minimum of two inches flex between ductwork and fan while running.
- B. Install in accordance with manufacturer's instructions.
- C. Provide sheaves required for final air balance on belt drive fans.
- D. Install backdraft dampers ceiling fan discharge.
- E. Install motorized backdraft dampers at locations indicated on the plans. Coordinate with electrical contractor for wiring of actuators.

3.03 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for minimum of up to one day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.04 CLEANING

A. Vacuum clean inside of fan cabinets; remove debris from dampers.

3.05 ADJUSTING

A. Coordinate with General Contractor for requirements for starting, adjusting and operational testing.

3.06 DEMONSTRATION

- A. Coordinate with General Contractors for requirements for demonstration and training.
- B. Demonstrate fan operation and maintenance procedures.

3.07 PROTECTION OF FINISHED WORK

- A. Section 23 05 00 General Mechanical Requirements: Requirements for protecting finished Work.
- B. Do not operate fans for until ductwork is clean, bearings lubricated, and fan has been test run under observation.

3.08 SCHEDULES - SEE DRAWINGS

END OF SECTION 23 34 00

SECTION 23 3600

AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Single Duct or Variable volume terminal units.
 - 2. Variable volume controls.
- B. Related Sections:
 - Section 23 05 48 Vibration Controls for HVAC Piping and Equipment: Vibration Isolators.
 - 2. Section 23 09 23 Direct-Digital Control System for HVAC: Controls remote from unit.

1.02 REFERENCES

- A. Air Condition, Heating and Refrigeration Institute:
 - 1. AHRI 260 Sound Rating of Ducted Air Moving and Conditioning Equipment.
 - 2. AHRI 410 Forced-Circulation Air Cooling & Air Heating Coils.
 - 3. AHRI 880 Air Terminals.
 - 4. AHRI 885 Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 Factory-Made Air Ducts and Connectors.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch wg.
- C. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Closeout requirements.
- B. Project Record Documents: Record actual locations of units and controls components.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting volume regulators.

1.05 QUALITY ASSURANCE

A. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with AHRI 880 and AHRI 885. Attach AHRI seal to each terminal unit.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION REQUIREMENTS

A. Coordinate with General Contractor prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

- Verify field measurements prior to fabrication.
- B. Insure services access is maintained; coordinate with other trades and General Contractor.

1.09 COORDINATION

- A. Coordinate with General Contractor to provide for coordination and readiness of project conditions.
- B. Coordinate Work with 23 09 23 Direct Digital Control System for HVAC and electrical, plumbing and ceiling trades.

PART 2 PRODUCTS

2.01 SINGLE DUCT VARIABLE VOLUME AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Metal-Aire.
 - 2. Environmental Technologies, Inc./Johnson Controls.
 - 3. Krueger.
 - 4. Titus.
 - 5. Trane
 - 6. Price.
 - 7. Engineer approved equal.
- B. Product Description: Variable air volume pressure-independent terminal units for connection to central air systems, with direct digital controls.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Basic Assembly:
 - 1. Casings: Minimum 22 gage galvanized steel.
 - 2. Lining: Minimum 1.0 inch thick dual density matte faced glass fiber insulation, minimum 1.5 lb./cu ft density, meeting NFPA 90A requirements and UL 181 and NFPA 90A erosion requirements.
 - 3. Plenum Air Inlets: Round stub connections for duct attachment.
 - 4. Plenum Air Outlets: S slip-and-drive connections.
- E. Basic Unit
 - 1. Configuration: Air volume damper assembly inside unit casing.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating (nylon is unacceptable) bearings; maximum damper leakage: 2 percent of design air flow at 1.5 inches rated inlet static pressure. Damper shaft shall be scored to indicate damper position. Incorporate mechanical stop to prevent overstroking.
 - 3. Unit shall not exceed 0.15 in. wg pressure drop at 2000 fpm inlet velocity (for basic terminal).
 - 4. Sound rating for the terminal shall not exceed scheduled NC levels. Rating shall be per AHRI std. 260.

F. Electric Heating Coil:

- 1. Construction: UL or ETL listed, slip-in type, open coil design, 80/20 nickel/chrome elements, integral NEMA 1 control box factory wired and installed, with:
 - a. Primary (auto reset) and secondary (manual reset) over-temperature protection.
 - b. Minimum airflow switch.
 - c. Integral door interlock disconnect switch.
 - d. Magnetic contactor for each step of control.
 - e. Terminal block for connections.
- 2. Electrical Characteristics: As scheduled on drawings. (Fuse per NEC.)
- 3. Position coil a minimum of 5" back from unit outlet to protect coil.
- G. Controls: Electronic Controls: Contain in NEMA Type 1 enclosure with access panel sealed from airflow and mounted on side of unit. Coordinate with controls subcontractor.
 - The terminals shall be equipped with pressure independent direct digital controls supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
 - 2. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. This sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm.
 - 3. Controls shall be field set by control contractor for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, and scheduled cfm.
 - 4. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch (Coordinate primary voltage with electrical contractor). Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.
 - 5. Actuator shall have a minimum of 35 in-lbs of torque and shall be mounted external to the unit but in the controls enclosure.
- H. Sequence of Operation: Refer to drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify ductwork is ready for air terminal installation.
- B. Coordinate voltage and maximum over-current protection with electrical trade. Coordinate power for controls transformers on any terminals without electric heat.
- C. Coordinate with General Contractor and all involved trades to ensure installation allows required service and maintenance access, including access door's removed/opening.

3.02 INSTALLATION

- A. Connect to ductwork in accordance with Section 23 31 00.
- B. Install ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure via vibration isolators. See specification 23 05 48 for requirements. Do not support from adjacent ductwork.
- D. Support air terminal units that are connected at inlet by flexible duct independently of that flexible duct. See detail on drawings.

E. Install reducer to transition from flexible duct size to inlet or outlet of variable air volume terminal. See detail on drawings for inlet conditions required.

3.03 ADJUSTING

- A. Coordinate with General Contractor and Commissioning Authority for requirements for starting, adjusting and operational testing.
- B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to scheduled minimum values. Coordinate with Test, Adjust and Balance Contractor.

END OF SECTION 23 36 00

SECTION 23 3700

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Diffusers.
 - 2. Registers
 - 3. Grilles.
 - 4. Louvers
- B. Related Sections:
 - 1. Section 23 33 00 Air Duct Accessories: Volume dampers for inlets and outlets.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, pressure drop and noise level.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

1.07 PRE-INSTALLATION COORDINATION

A. Coordinate with General Contractor and affected trades prior to installation.

PART 2 PRODUCTS

2.01 DIFFUSERS, REGISTERS AND GRILLES

- A. Manufacturers:
 - 1. Krueger.
 - 2. Metal-Aire.
 - 3. Nailor.

- 4. Price.
- 5. Titus.
- 6. Engineer approved equal.
- B. See schedule on drawings for further information.

2.02 LOUVERS

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Ruskin.
 - 3. United Enertech.
 - 4. Engineer approved equal.
- B. Product Description: Stationary, wind driven louver with double drainable blades.
- C. Type: 5 inch deep with blades on 45 degree slope, heavy channel frame.
- D. Fabrication: 0.081 inch thick extruded aluminum, welded assembly, with factory baked enamel finish. Color shall be specified by the Architect.
- E. Mounting: Furnish with full perimeter, 1-1/2 inch wide, integral flat flange on exterior side of louver.
- F. Insect Screen: Aluminum mesh, set in aluminum frame.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Coordinate with General Contractor and affected trades prior to installation.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

3.02 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black.
- D. Field paint air devices as required per the Architect where deemed necessary to maintain the aesthetic appearance of each facility.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.04 SCHEDULES - SEE DRAWINGS

END OF SECTION 23 37 00

SECTION 23 7300

INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes indoor factory fabricated modular air-handling units and accessories.
- B. Related Sections:
 - Section 23 05 48 Vibration Controls for HVAC Piping and Equipment: Vibration Isolators
 - 2. Section 23 07 00 HVAC Insulation: Product requirements for insulation for placement by this section.
 - 3. Section 23 09 23 Direct-Digital Control System for HVAC: Controls remote from unit.
 - 4. Section 23 23 00 Refrigerant Piping: Product requirements for refrigerant piping connections to air handling units.
 - 5. Drawings: Sequences of operation applying to units in this section.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 Standards Handbook.
 - 2. AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 5. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning, Heating and Refrigeration Institute:
 - 1. AHRI 410 Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. AHRI 430 Central-Station Air-Handling Units.
 - 3. AHRI 640 Performance Rating of Commercial and Industrial Humidifiers.
 - 4. AHRI Guideline D Application and Installation of Central Station Air-Handling Units.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 Motors and Generators.
- E. National Fire Protection Association:
 - 1. NFPA 54 National Fuel Gas Code.
 - 2. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- F. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- G. Underwriters Laboratories Inc.:
 - 1. UL 900 Air Filter Units.
 - 2. UL Fire Resistance Directory.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.
- B. Shop Drawings:
 - Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Product Data, Submit the following:

- Published Literature: Indicate capacities, (per AHRI stds.) ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
- 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
- 3. Fans: Performance with specified operating point plotted and family of curves for the selected fan wheel, power, RPM.
- 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity, for each octave.
- 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- 6. Manufacturer's installation instructions.
- D. Manufacturer's Certificate:
 - 1. Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Outside Air/Return Air Damper Leakage:
 - 1. Test in accordance with AMCA 500.
- B. Gas Furnaces:
 - 1. Unit shall be certified in accordance with ANSI Z21.47b and ANSI Z83.8.

1.05 CLOSEOUT SUBMITTALS

- A. Section 23 03 00 General Mechanical Requirements: Closeout procedures.
- B. Operation and Maintenance Data:
 - 1. Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, wiring diagrams and local representative's name, address and phone number.

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer
 - 1. Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. Coordinate with General Contractor and other related trades prior to laying out equipment and supporting pads/racks. Also coordinate delivery times and access to air handler rooms.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 03 00 General Mechanical Requirements: Product storage and handling requirements.
- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.09 WARRANTY

- A. Coordinate with General Contractor to provide product warranties and product bonds.
- B. Furnish one year manufacturer warranty for air handling units.
- C. Furnish 10 year prorated warranty for heat exchangers.

1.10 EXTRA MATERIALS

A. In addition to construction and start-up sets, furnish one additional set of filters for each unit; deliver to owner at project completion.

PART 2 - PRODUCTS

2.01 AIR HANDLING UNITS

- A. All air handling units shall be subject to the performance data indicated on the drawings as well as the construction features and capabilities listed in these specifications. Regardless of a manufacturer being listed in the following sections, each unit shall not exceed the listed weight as indicated on the drawings. The equipment vendor/manufacturer shall be fully and solely responsible for any design and/or construction costs required to accommodate larger/heavier units or units.
- B. Manufacturers:
 - 1. Aaon.
 - 2. Addison.
 - 3. Daikin Applied.
 - 4. Trane.
 - 5. York.
 - 6. Engineer approved equal.
- C. Configuration: Fan section plus accessories, including:
 - 1. Gas heating section AHU-H3, AHU-H4, & AHU-H6
 - 2. Electric heating section (FC-H1 & FC-H2)
 - 3. Cooling coil section.
 - 4. Filter section.
 - 5. Mixing box section.
- D. Performance Base:
 - 1. Sea level pressure or altitude.
- E. Fabrication: Conform to AMCA 99 and AHRI 430.
- F. Product Description: Provide factory fabricated, tested and wired modular air handling unit consisting of casing and frame, variable speed supply fans, cooling coil, hot gas reheat coil, filter rack, electrical components and controls as specified.
- G. Identification: Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.

2.02 UNIT CASING

- A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel and finished with baked enamel finish (manufacturer's standard color). The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.
- B. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipping loose gasketing is not acceptable.
- C. Panels and access doors shall be constructed as a 2.0-inch nominal thick; thermally broken double wall assembly, injected with foam insulation with an R-value of not less than R-13.0. Panels and access doors shall be constructed as a 1.0-inch nominal thick; thermally broken double wall assembly, injected with foam insulation with an R-value of not less than R-6.5.
 - 1. The inner liner shall be constructed of G90 galvanized steel.
 - 2. The outer panel shall be constructed of G90 galvanized steel.

- 3. The floor plate shall be constructed as specified for the inner liner.
- 4. Unit will be furnished with solid inner liners.
- D. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.
- E. The casing leakage rate shall not exceed 1% of total air flow of unit.
- F. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
- G. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.
- H. Provide unit with 6.0 inch high formed 12 gage G60 galvanized steel base rail for structural rigidity and condensate trapping.
- I. Construct drain pans from 304 stainless steel with double sloped pitch to drain connection. Provide drain pans under cooling coil section.

2.03 SUPPLY FAN SECTION

- A. Fan: Non-overloading, direct drive, unhoused, backward curved, plenum type.
- B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts.
- C. Fan motors shall be heavy-duty ODP or TEFC type with grease lubricated ball bearings. Motors shall be premium efficiency. Motors shall be suitable for use in variable speed applications. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range. High efficiency ECM motors are an acceptable alternate to VFD driven motors.
- D. Supply Fan Modulation:
 - 1. For VFD driven fans, an electronic variable frequency drive shall be provided for the supply air fan regardless of variable volume or constant volume operation. Each drive shall be factory installed out of the air stream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.
 - 2. The unit manufacturer shall install all power and control wiring.
 - 3. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.
- E. The supply fans shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.04 DIRECT EXPANSION COILS

A. Certification: Acceptable refrigerant coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered, provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9001 certified.

- B. Direct expansion refrigerant cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 3" beyond unit casing for ease of installation. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.
- C. Coil shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
- D. Cooling coils with two circuits shall have interlaced circuitry.
- E. The cooling coil shall be factory leak tested with high-pressure air under water.
- F. Coil shall be furnished with a factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.
- G. Coil shall have left or right hand external piping connections (see plans). Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.
- H. Refrigeration circuit shall be equipped with a liquid line sight glass.
- I. Modulating Hot Gas Reheat Coil (Applies to all units except AHU-H5).
 - 1. Modulating hot gas reheat shall be provided on the lead refrigeration circuit. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal that allow the unit to have a dehumidification mode of operation and includes supply air temperature control to prevent supply air temperature swings and overcooling of the space. Modulating reheat valves shall be factory installed in the matching AAON condensing unit. Reheat line connections shall be labeled, extend beyond the unit casing and be located near the suction and liquid line connections for ease of field connection. Connections shall be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

2.05 GAS HEATING SECTION (APPLIES TO AHU-H3, AHU-H4, & AHU-H6):

- A. Fuel: Natural gas.
- B. Gas furnaces shall be located in the reheat position downstream of the supply fan.
- C. The heaters shall be indirect fired type with a minimum 5:1 turndown capability.
- D. The furnace shall consist of a gas valve, stainless steel heat exchanger tubes with an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
- E. Stainless steel heat exchanger shall carry a 10 year prorated warranty, from the date of original equipment shipment from the factory.
- F. Furnace shall include a gas ignition system consisting of a direct spark electronic igniter and remote flame sensor to prove carryover across all burners.
- G. The gas furnace shall have a manual reset flame rollout switch and automatic reset high limit switch to limit maximum outlet air temperature to less than 250°F.
- H. Furnace shall include a single gas connection and have gas supply piping entrances in the outside cabinet wall below the access door of the gas heat module.

2.06 ELECTRIC HEATING SECTION (APPLIES TO FC-H1 & FC-H2 ONLY):

- A. Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in contactors, galvanized steel frame, control circuit transformer and fuse, air flow proving device and load fuses.
- B. Heater shall have full modulation capacity controlled by an SCR.

2.07 FILTERS

- A. Provide factory-fabricated flat filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.
- B. Magnahelic pressure gauge shall be furnished and mounted by the manufacturer.
- C. All units except FC-H1, & FC-H2 shall include 2.0 inch thick pleated panel pre-filters with MERV 8 rating and 4.0 inch thick, pleated panel filters with MERV 11 rating. FC-H1, & FC-H2 shall include 2.0 inch thick pleated panel filters with MERV 8 rating only.
- D. The contractor shall furnish and install, at building occupancy, a new, clean set of filters.

2.08 MIXING BOX DAMPERS (APPLIES TO ALL UNITS EXCEPT FC-H2)

- A. Mixing box section shall be provided with openings at locations indicated on the drawings. Openings shall be provided with dampers with parallel low leak airfoil blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Damper Leakage: Leakage rate shall be less than two tenths of one percent at 2.0 inches static pressure differential when tested in accordance with AMCA Standard 500.
- B. Provide economizer components and controls in accordance with IECC 2012 requirements.
 - 1. Furnish economizer with fixed limit enthalpy control.
 - 2. Furnish with fault detection diagnostic capabilities.

2.09 OUTSIDE AIR MEASURING DEVICE (APPLIES TO AHU-H3, AHU-H4, AHU-H5, & AHU-H6)

A. See 23 09 23 for measuring station requirements.

2.10 ELECTRICAL

- A. Unit shall be provided with standard power block for connecting power to the unit.
- B. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
- C. Unit shall include a factory installed 24V control circuit transformer.
- D. Unit shall be provided with Phase protection (3-phase units) against phase loss, reversal, and imbalance.

2.11 CONTROLS

- A. Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted. Controller shall be capable of communicating with the BACnet building automation system via BACnet MS/TP.
- B. Unit controller shall be capable of controlling all features and options of the unit.
- C. Controller shall be capable of standalone operation with unit configuration and set point adjustment without dependence on a building management system.

- D. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
- E. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of power failure.
- F. Refer to Section 23 09 23 and Drawing for additional requirements.

2.12 CAPACITY

A. See Drawings for schedules.

2.13 ELECTRICAL CHARACTERISTICS

A. See Drawings and schedules.

PART 3 - EXECUTION

3.01 INSTALLATION

- Install in accordance with ARI 430.
- B. Install assembled units on spring isolators per specification 23 05 48. Where fans are provided with internal spring isolators, contractor shall render them inoperable. Install restraining snubbers as part of manufacturer's product. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- C. Install condensate piping with trap as indicated on drawings and route from drain pan to condensate drainage system.
- D. Install auxiliary drain pan constructed of galvanized steel w/welded seams under entirety of air handling unit. Provide moisture sensing kill switch in drain pan. See plans for additional information.

3.02 INSTALLATION - REFRIGERANT COILS

- A. Install piping specialties in accordance with manufacturer's recommendations.
- B. Furnish services of factory trained representative for minimum of 4 hours per unit to refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.03 INSTALLATION - GAS FURNACE

- A. Connect natural gas piping in accordance with NFPA 54.
- B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
- C. Install the following piping accessories on natural gas piping connections. Refer to Section 22 11 23.
 - 1. Strainer.
 - 2. Pressure gage.
 - 3. Shutoff valve.
 - 4. Pressure reducing valve.
 - 5. Dirt Leg.
- D. Install combustion air and flue vent piping per specification 23 51 00.

3.04 CLEANING

- A. Vacuum clean coils and inside of unit cabinet. Comb any damaged coil fins.
- B. Install initial set of pleated filters during construction period. Replace with new set of filters at Substantial Completion. Turn over one additional new set of filters to owner's representative.

3.05 ADJUSTING

A. Coordinate with General Contractor and Commissioning Authority for requirements for starting, adjusting and operational testing.

3.06 DEMONSTRATION

- A. Demonstrate unit operation and maintenance.
- B. Furnish services of manufacturer's technical representative for one 4 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.07 PROTECTION OF FINISHED WORK

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.08 SCHEDULES

A. See Drawings.

END OF SECTION 23 73 00

SECTION 23 8125

SPLIT-SYSTEM AIR-CONDITIONING CONDENSING UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Condensing unit (Indoor DX coil is covered in Section 23 73 00).
- B. Related Sections:
 - Section 23 05 48 Vibration Controls for HVAC Piping and Equipment: Vibration isolators.
 - 2. Section 23 07 00 HVAC Insulation: Piping insulation.
 - 3. Section 23 09 23 Direct-Digital Control System for HVAC: Controls remote from unit.
 - 4. Section 23 23 00 Refrigerant Piping: Product requirements for refrigerant piping connections to condensing units.
 - 5. Section 23 73 00 Indoor Central Station Air Handling Units: Cooling coils.
 - 6. Drawings: Sequences of operation applying to units in this section.

1.02 REFERENCES

- A. Air-Conditioning, Heating and Refrigeration Institute:
 - 1. AHRI 210/240 Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. AHRI 270 Sound Rating of Outdoor Unitary Equipment.
 - 3. AHRI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - 4. AHRI 365 Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
- C. ASTM International:
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 Motors and Generators.
- E. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements.
- B. Product Data:
 - 1. Submit data indicating:
 - a. Cooling capacities.
 - b. Dimensions.
 - c. Weights.
 - d. Rough-in connections and connection requirements.
 - e. Duct connections.
 - f. Electrical requirements with electrical characteristics and connection requirements.
 - g. Provide cross plot of performance (AHRI) of condensing unit matched with coil in air handling unit.
 - h. Controls.
 - i. Accessories.
- C. Manufacturer's Installation Instructions:
 - Submit assembly, support details, connection requirements, and include start-up instructions.

- D. Manufacturer's Certificate:
 - 1. Certify Products meet or exceed specified requirements.
- E. Manufacturer's Field Reports:
 - 1. Submit start-up report for condensing unit.

1.04 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Closeout procedures.
- B.
- C. Project Record Documents:
 - 1. Record actual locations of controls installed remotely from units.
- D. Operation and Maintenance Data:
 - Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Performance Requirements:
 - 1. Energy Efficiency Rating (EER) not less than prescribed on drawings when used in combination with compressors and evaporator coil (in air handler) when tested in accordance with AHRI 210/240 or AHRI 340/360.
- B. Cooling Capacity:
 - 1. Rate in accordance with AHRI 210/240, AHRI 340/360 or AHRI 365 as applicable.
- C. Insulation and adhesives:
 - 1. Meet requirements of NFPA 90A.

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer:
 - Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION COORDINATION

- A. Coordinate with General Contractor prior to equipment installation.
- B. Coordinate with GC on weight/location of condensing unit.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept unit and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

1.09 COORDINATION

- A. Coordinate with General Contractor and other related trades for layout and utility connections.
- B. Coordinate installation of condensing units with housekeeping pad and disconnect racks.

1.10 WARRANTY

- A. Coordinate with General Contractor to provide for warranties.
- B. Furnish one year manufacturer's parts warranty and five year compressor warranty.

PART 2 PRODUCTS

2.01 SPLIT SYSTEM AIR CONDITIONING CONDENSING UNITS

- A. Manufacturers:
 - 1. Same manufacturer as air handling unit no exceptions.
- B. Product Description:
 - Split system consisting of air handling unit DX coil (specified in 23 73 00) and condensing unit including cabinet, compressors, refrigeration circuits, condenser, controls, condensing unit accessories, and refrigeration specialties.
- C. Identification: Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.

2.02 CASING

- A. Cabinet:
 - 1. Unit shall be completely factory assembled, piped, wired and shipped in one section.
 - 2. Access to compressors and controls components shall be through hinged access doors with quarter turn, lockable handles.
 - 3. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

2.03 CONDENSER SECTION

- A. The condensing section shall be open on the sides to allow airflow through the coils. Condenser coils shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
- B. Coils either be recessed so that the cabinet provides built in hail protection or louvered hail guards shall be provided.
- C. Condenser fans shall be high efficiency electrically commutated motors or VFD driven for condenser head pressure control. The factory provided ECM fans or VFD driven fans shall continuously modulate the fan air flow to maintain head pressure at acceptable levels.
- D. Condenser fans shall be capable of maintaining head pressure to allow operation down to 25°F.

2.04 REFRIGERATION SYSTEM

- A. Compressors shall be R-410A scroll type with thermal overload protection. Each compressor shall be furnished with a crankcase heater.
- B. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.
- C. Compressors shall be isolated from the base pan with rubber vibration isolators to reduce compressor sound transmission.
- D. Lead refrigeration circuit shall include a 10-100% variable capacity compressor.
- E. All lag refrigeration circuits shall be provided with external hot gas bypass to protect against evaporator frosting and to prevent excessive compressor cycling.

- F. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line (insulated hot gas bypass line) (insulated hot gas line) and insulated suction line.
- G. Unit shall include a factory holding charge of R-410A refrigerant and oil.
- H. Where indicated on the drawings, the lead refrigeration circuit shall be provided with hot gas reheat coil in the matching air handler, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
- I. HP-H1 shall be configured as an air source heat pump. Each refrigeration circuit shall be equipped with a liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils.

2.05 SYSTEM CONTROLS

- A. Provide standard terminal block for field installation of controls.
- B. Heat pump units shall include defrost controls to prevent frost accumulation on the outdoor coil during heat pump heating operation.

2.06 ACCESSORIES:

- A. Furnish condensing units with the following accessories:
 - 1. Control circuit transformer.
 - 2. Time delay relay.
 - 3. Anti-short cycle timer.
 - 4. Non-fused disconnect switch.
 - 5. Suction and discharge service ports.
 - 6. Phase protection (3-phase units) against phase loss, reversal, and imbalance.

2.07 CAPACITY

A. See Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Coordinate with General Contractor for verification of existing conditions before starting work.
- B. Verify concrete pad for condensing unit is ready for unit installation.

3.02 INSTALLATION - CONDENSING UNIT

- A. Install condensing units on vibration isolation pads. See specification 23 05 48 for requirements.
- B. Install condensing units on concrete housekeeping pads as specified in 23 05 29.
- C. Install refrigerant piping from air handling unit to condensing unit. Install refrigerant specialties per manufacturer's recommendations and specification 23 23 00. Provide suction line insulation and weather protection as specified in Section 23 07 00.
- D. Evacuate refrigerant piping and install initial charge of refrigerant.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between air handling unit, condensing unit, and field installed accessories.

G. Install connection to electrical power wiring in accordance with Division 26. Coordinate with electrical trade.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Provide start up by manufacturer or designated representative.
- B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.04 CLEANING

A. Vacuum clean condenser coils and inside of unit cabinet.

3.05 ADJUSTING

A. Coordinate with General Contractor and Commissioning Authority for requirements for starting, adjusting and operational testing.

3.06 DEMONSTRATION

- Coordinate with General Contractor, Commissioning Authority and Controls Contractor for demonstration and training.
- B. Demonstrate starting, maintenance, and operation of condensing unit.
- C. Furnish services of manufacturer's technical representative for one 4 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.07 SCHEDULES

A. See drawings.

END OF SECTION 23 81 25

SECTION 23 8127

MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wall-mounted fan coil unit.
 - 2. Condensing unit.
- B. Related Sections:
 - Section 23 05 48 Vibration Controls for HVAC Piping and Equipment: Vibration isolators.
 - 2. Section 23 07 00 HVAC Insulation: Piping insulation.
 - 3. Section 23 23 00 Refrigerant Piping: Product requirements for refrigerant piping connections to condensing units.

1.02 REFERENCES

- A. Air-Conditioning, Heating and Refrigeration Institute:
 - 1. AHRI 210/240 Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. AHRI 270 Sound Rating of Outdoor Unitary Equipment.
 - 3. AHRI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - 4. AHRI 365 Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
- C. ASTM International:
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 Motors and Generators.
- E. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Section 23 05 00 Mechanical General Requirements: Submittal procedures.
- B. Product Data:
 - 1. Submit data indicating:
 - a. Cooling capacities.
 - b. Dimensions.
 - c. Weights.
 - d. Rough-in connections and connection requirements.
 - e. Electrical requirements with electrical characteristics and connection requirements.
 - f. Controls.
 - g. Accessories.
- C. Manufacturer's Installation Instructions:
 - Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Certificate:
 - 1. Certify Products meet or exceed specified requirements.

- E. Manufacturer's Field Reports:
 - 1. Submit start-up report for each unit.

1.04 CLOSEOUT SUBMITTALS

- A. Section 23 05 00 General Mechanical Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data:
 - 1. Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Performance Requirements:
 - Season Energy Efficiency Rating (SEER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240.
- B. Cooling Capacity:
 - 1. Rate in accordance with ARI 210/240.
- C. Sound Rating:
 - 1. Measure in accordance with ARI 270.
- D. Insulation and adhesives:
 - 1. Meet requirements of NFPA 90A.

1.06 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum five years documented experience and local representation.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Section 23 05 00 General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.08 COORDINATION

- A. Coordinate with General Contractor prior to installation of equipment.
- B. Coordinate installation of fan coil units with building structure.

1.09 WARRANTY

- A. Coordinate with General Contractor for requirements for warranties.
- B. Furnish five year manufacturers warranty for compressors.

PART 2 - PRODUCTS

2.01 Manufacturers:

- A. Acceptable manufactures:
 - Daikin.
 - 2. LG.
 - 3. Mitsubishi.
 - 4. Trane.
 - 5. Engineer approved equal.

2.02 INDOOR UNIT (Wall Mounted)

- 1. General:
- 2. Indoor unit, where indicated, shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within the conditioned space. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with a local controller. A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment.
- 3. Fan:
- 4. The fan shall be direct-drive type, statically and dynamically balanced impeller with high and low fan speeds available.
- Coil:
- 6. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
- 7. Condensate Pump (if required):
- 8. Provide little giant condensate pump for each fan coil unit, model VCMA-20, 115V/1PH, 1.5A, 60GPH@7 ft. with ½ gallon tank, UL listing, power cord, check valve. Install in drain pan per details on drawings.

B. Electrical:

- 1. The unit electrical power shall be 115 volts (or 208), 1 phase, 60 hertz. Unless otherwise noted, coordinate power with outdoor unit; indoor unit shall derive its power from the outdoor unit. Coordinate with electrician if 208 volts for indoor unit. (Note that other voltages for the indoor unit are not acceptable.)
- 2. The system shall be capable of satisfactory operation within 10% of nominal voltage.
- 3. The indoor unit shall not have any supplemental electrical heat elements.

C. Control:

- This unit shall perform input functions necessary to operate the system, using the hard wired controller/thermostat. The controller shall consist of a Power On-Off switch, Cool/Dry-Fan selector, Thermostat setting, Timer Mode, fan speed selector, Auto Vane selector, Test Run switching and Check Mode switching.
- 2. Temperature changes shall be by 2°F increments with a range of 65-87°F.
- 3. The system shall be capable of automatic restart when power is restored after power interruption. System shall operate 24x7, 365 days per year, with a setpoint adjustable at the secured controller only.
- 4. Control system shall control the continuous operation of the air sweep louvers.
- 5. Provide manufacturer's <u>hard-wired</u> controller with LCD display.

2.03 OUTDOOR UNIT

A. General:

- The units shall be equipped with a circuit board that interfaces to the indoor unit and perform all functions necessary for operation. The unit must have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit must be run tested at the factory.
- B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

- 1. The unit shall be furnished with a direct drive propeller type fan.
- 2. The motor shall have inherent protection, be permanently lubricated bearings.
- 3. The fan motor shall be mounted for quiet operation.
- 4. The fan shall be provided with a raised guard to prevent contact with moving parts.

D. Coil:

- 1. The condenser coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
- 2. The coil shall be protected with an integral metal guard.
- 3. Refrigerant flow from the condenser shall be controlled by means of an expansion valve.

E. Compressor:

- 1. The compressor shall be a high performance scroll, R410a.
- 2. A crankcase heater shall be factory mounted on the outside of the compressor.
- 3. The outdoor unit shall have an accumulator.
- 4. The compressor will be equipped with an internal thermal overload.
- 5. The outdoor unit shall have a high-pressure safety switch.
- 6. The outdoor unit must have the ability to operate with a maximum height difference of 100 feet and have refrigerant tubing length of 100 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.
- 7. The compressor shall be mounted to avoid the transmission of vibration.
- 8. The outdoor unit shall be capable of operating at 0°F ambient temperature.

F. Electrical:

- 1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
- 2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
- 3. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
- 4. The control wiring between the indoor unit and the outdoor unit shall be shielded or in a separate conduit.
- 5. Power for indoor unit shall be from the outdoor unit; provide conduit with a motor-rated disconnect switch at indoor unit. Coordinate with electrical contractor if voltage is different.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify concrete housekeeping pad is ready to accept equipment.

3.02 INSTALLATION - FAN COIL UNIT

- A. Install fan coil per manufacturer's instructions.
- B. Install condensate piping without trap and route from unit to condensate drainage system.
- C. Install components furnished loose for field mounting.
- D. Install connection to electrical power wiring in accordance with manufacturer's instructions and Div. 26 specifications.

3.03 INSTALLATION - CONDENSING UNIT

- A. Install condensing units on vibration isolation pads. See specification 23 05 48 for requirements.
- B. Install condensing units on concrete housekeeping pads as specified in 23 05 29.

- C. Install refrigerant piping from fan coil unit to condensing unit. Install refrigerant specialties furnished with unit. Install refrigerant specialties per manufacturer's recommendations and specification 23 23 00. Provide suction line insulation and weather protection as specified in Section 23 07 00.
- D. Install electrical devices furnished loose for field mounting.
- E. Install control wiring between fan coil unit, condensing unit, and field installed accessories.
- F. Install connection to electrical power wiring in accordance with manufacturer's instructions and Div. 26 specifications.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Coordinate with General Contractor to provide manufacturer's field services.
- B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.05 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

3.06 DEMONSTRATION

- A. Demonstrate fan coil unit operation and maintenance to owner.
- B. Demonstrate starting, maintenance, and operation of condensing unit including low ambient temperature operation.

3.07 PROTECTION OF FINISHED WORK

A. Do not operate fan coil units until unit is clean, filters are in place and fan has been test run under observation.

3.08 SCHEDULES

A. See schedule on drawings.

END OF SECTION 23 81 27

SECTION 26 0500

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders govern work of Division 26 sections.
- B. Contractor shall provide items, articles, materials, operations, and methods listed, mentioned, or scheduled on the Drawings and specifications, including labor, materials, equipment, and incidentals required for their completion.
- C. Work shall conform to requirements of locally adopted codes and ordinances; applicable building codes; applicable code sections of NFPA standards; and interpretations of the authority having jurisdiction.
- D. Work shall conform to Owner's General Conditions and Special Conditions.

1.02 SCOPE OF WORK

- A. Requirements of Division 26 sections shall govern installation of materials specified, including those related to the work of other disciplines, even where not referenced by other division's specification.
- B. Where items specified in specific Division 26 section conflict with requirements in this section, the specific section shall govern.
- C. Contractor shall supply labor, equipment, and materials in strict accordance with Drawings and specifications. Contractor shall provide conductors, cabling, connections, and accessories required for complete and functional systems, even where not specifically shown on the Drawings.
- D. Finish prime and painting is specified in other Divisions. Prime and painting specified under Division 26 is limited to protective coatings, rust inhibiting, and identification.

1.03 REFERENCES

- A. Where reference is made to standards, codes, specifications, and recommendations, it is understood that the latest edition of the publication adopted and published at the date of the Contract Documents is that which is referenced, unless a specific date is stated.
- B. References to technical societies, organizations, governmental agencies, laws, and publications made in specifications are in accordance with the following abbreviations:

1.	ADA	Americans with Disabilities Act
2.	ANSI	American National Standards Institute
3.	ASME	American Society of Mechanical Engineers
4.	ASTM	American Society for Testing and Materials

5. CSD Commodity Standards Division U.S. Dept of Commerce

6. IEEE Institute of Electrical and Electronic Engineers

NFPA National Fire Protection Association
 NBS National Bureau of Standards
 NEC National Electrical Code (NFPA 70)

10. NEMA National Electrical Manufactures Association

11. TAS Texas Accessibility Standards12. UL Underwriters' Laboratories, Inc.

1.04 DEFINITIONS

A. Where the terms such as "Acceptable", "Equal", and "Equivalent" are used in Drawings and specifications, it is understood that judgment of Architect shall govern such decision.

- B. Where terms such as "Approved", "Directed", "Requested", "Authorized", "Selected", "Required", and "Permitted" are used in Drawings and specifications, it is understood that instruction is that of the Architect.
- C. Terms such as shown, noted, scheduled, and specified are intended to help the reader locate referenced information. Term should not be interpreted as limiting location(s) of applicable information.
- Definitions of terms and expressions used in electrical work: D.
 - 1. Furnish: Supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
 - 2. Install: 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: Both the furnishing and installation, complete and ready for operation.
 - 4. Indicated: Graphically represented, noted, or scheduled on the Drawings; cited by Paragraphs or Schedules in specifications; or similarly required in the Contract Documents.
 - 5. Listed: Tested, approved, and certified by a qualified product listing organization, as meeting appropriate safety standards as applicable to the product and intended installation application.
- E. NEMA Classifications: (For complete definitions and listing see NEMA Standards)
 - General Purpose, Indoor. 1. Type 1
 - Drip-proof, Non-corrosive, Indoor. 2. Type 2
 - 3. Type 3R 4. Type 4 Rain proof. Outdoor.
 - Watertight and dust-tight, non-corrosive, indoor and outdoor.
 - Watertight and dust-tight, corrosion resistant, indoor and outdoor. 5. Type 4X
 - 6. Type 12 Dust-tight, watertight, non-corrosive, indoor.

1.05 DRAWINGS

- Α. Drawings and Instructions:
 - 1. Drawings for Division 26 work are in part diagrammatic, intended to convey the scope of work and general arrangement of equipment, fixtures, interlocks, conduit, and outlets. Division 26 installer shall follow Drawings in laying out the work, consult other trades and general construction drawings, and coordinate spaces in which the work will be installed.
 - 2. Drawings and specifications shall be considered as complementary parts of the Division 26 work and of the Contract Documents. Study Drawings and specifications for Division 26 work, as well as that of other trades to fully understand the work to be performed.
 - 3. As a qualification for bidding, visit the site and identify existing conditions that may affect Division 26 work prior to submitting a proposal.
- B. Locations and Scaling:
 - 1. Prior to locating electrical equipment, outlets, switches, and similar devices, obtain approval from Architect as to exact location. Locations shall not be determined by scaling Drawings.
 - 2. Mounting heights shall be as directed by Architect and in accordance with the TAS and
 - 3. Material, equipment, and labor required to redo installation, restore structure, and repair finishes due to failure to comply with this requirement shall be the responsibility of Contractor.

1.06 DISCREPANCIES

- Clarifications: Obtain necessary clarifications as to discrepancies, omissions, and questions A. regarding the intent of the Contract Documents, before submitting a proposal.
- B. Contractor Agreement:

- 1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.
- C. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner.
- D. Codes and Standards:
 - 1. Perform the work in strict accordance with requirements and recommendations of applicable codes and standards. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
 - 2. When two or more codes or standards are applicable to the same work, the stricter code or standard shall govern.
 - 3. Correct deficiencies caused by failure to comply with written codes or standards at no additional cost to Owner.

1.07 PRODUCT SUBSTITUTION PROCEDURES

- Architect will consider requests for substitution, received a minimum of 10 days prior to scheduled bid date.
- B. Substitutions will be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each Request for Substitution with complete data substantiating compliance of proposed substitution with Contract Documents.
- D. Submission of Request for Substitution represents that Contractor:
 - 1. Has investigated proposed product and has determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for substituted materials and installation as for specified product.
 - 3. Will coordinate and revise installation, including consideration for the work of other trades, to ensure the work is complete and operable.
 - 4. Waives claims for additional costs or time extension, except as specifically stated in the Request for Substitution.
 - 5. Will reimburse Owner and Architect for review and redesign services that may be required.
 - 6. Will pay additional review, permit, and inspection fees associated with securing re-approval of authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure: As required by Division 1.

1.08 SUBMITTALS

- A. Submittal Procedures: Division 1 Requirements in addition to the following:
 - 1. Submittal Preparation:
 - a. At Contractor's option, digital electronic copy may be used for submittals that do not designate otherwise or require physical demonstrations, such as color samples or scalable templates. Digital electronic copies shall be original electronic copies from the manufacturer and shall include electronically searchable text. Scans made by the Contractor are not acceptable. Reference to indexing of material below may be accomplished in electronic media with bookmarks or by separation into distinct files.
 - b. Where digital electronic copy is not used, a minimum of six copies hard copy notebooks shall be provided. Notebooks shall be delivered to the Architect in a neat

- and professional manner. Reference to indexing below shall be accomplished by named or numbered tabs.
- c. Submittals shall be provided complete with all sections at one time, indexed to each Section of Specifications, and shall include the following information:
 - 1) Project Name
 - 2) Date
 - 3) Name and Address of Architect
 - 4) Name and Address of Engineer
 - 5) Name, Address and Telephone Number of Contractor and sub-contractors.
 - 6) Manufacturer's Name
 - 7) Published ratings or capacity data
 - 8) Detailed equipment drawing for fabricated items
 - 9) Wiring diagrams
 - 10) Installation instructions
 - 11) Other information as required by the relevant section(s)
- d. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with highlighting, or other means of identification clearly legible.
- e. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect. In such cases, a list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle Contractor to an extension of contract time, and no claim for extension due to such Contractor default shall be allowed.

B. Submittal Organization:

- 1. Organize all required data in digital electronic copy, or hard copy in a 3-ring black binder of sufficient size with index tabs with number and appropriate title of specification section.
- If submitted digitally, all sections shall be submitted at once, broken out by specification section into separate PDF documents. Each individual specification section submittal shall be provided with an individual cover sheet to allow for individual review of the submittal.
- 3. Provide a cover sheet and an index sheet listing all items submitted.
- 4. The second and third sheet shall be blank for stamping of submittals. All submittals are to be processed at same date; partial submittals will not and are not acceptable.
- 5. Show any revisions to equipment layout required by use of selected equipment.
- C. Architect shall receive submittals no later than thirty (30) working days from contract date with Contractor and Owner.
- D. Review of submittals is only for confirmation of adherence to design of project and does not relieve Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.09 SHOP DRAWINGS

A. As soon as practical and within thirty days after the official award of contract and before any materials and equipment are purchased, Contractor shall submit to the Architect, for review, five (5) copies of the complete list of all materials and equipment identified and referenced to specification paragraphs together with applicable shop drawings. In addition, the names and addresses of the manufacturers, their catalog data, numbers, and trade names shall be furnished. Published performance data shall be furnished to indicate compliance with scheduled performance. This data will be marked "Reviewed" by the Architect, dated and distributed to the several parties involved, with two (2) copies returned to Contractor. The data shall include the following:

- Equipment-room layouts drawn to 1/4" scale, including equipment and accessories, to show clearances for operating and servicing. This is to include Electrical Rooms, MDF/IDF (type) Rooms, Mechanical Rooms.
- 2. Equipment and materials as indicated in each Section.
- 3. Composite drawings of crowded locations where there is a possibility of conflict among trades.

B. Verification of Dimensions:

- Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. Contractor shall verify all dimensions in the field and advise the Architect of any discrepancy before performing the work. Adjustments to the work required to facilitate a coordinated installation shall be made at no additional cost to the Owner.
- C. Equipment other than that shown should be used in bids only when approved by the Architect prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, connections, piping, etc. which shall be paid for by Contractor. In the event that Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect reserves the right to reject this equipment, and Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:

- 1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions.
- E. Submit such directions to Architect prior to time of installation for use in review of the work.
- F. Operating Instructions, Charts:
 - 1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect, require such instructions; obtain receipt for it.
- G. When so specified or instructed, mount operating instructions in approved frame with glass over: locate where directed.

1.10 PROJECT RECORD DOCUMENTS

- A. Keep a set of plans on the job, noting daily all changes to the final location and exact dimensions of switchgear, devices, fixtures, equipment, and site utilities.
- B. Turn over record document submittals (as outlined in Division 1 General Requirements of the Specifications) to the Architect, upon submitting his request for final payment.
- C. Compile the following data daily during the work, and turn over to Architect two (2) copies, prepared in 3-ring binders for Owner's records:
 - 1. Cover page(s) identifying the names, addresses, and telephone numbers of the following: Contractor, all sub-contractors, and all major equipment suppliers.
 - Warranty and guarantee statements from manufacturers, Contractor, and each subcontractor.
 - 3. Manufacturer's equipment operations manual and equipment maintenance instructions.
 - 4. Manufacturer's documentation on preventative maintenance recommendations, seasonal changeover procedures, and troubleshooting procedures.
 - 5. Repair parts lists for equipment and materials including name, address, and telephone number of local supplier or agent.
 - 6. Documentation of test methods, including test reports, results, and logs, as required by specific sections of the specifications.

7. Shop Drawings, other data, and drawings required during course of the work.

1.11 GENERAL

A. Lines and Grades:

- Construct work in conformity with lines and grades as indicated, using axis lines and benchmarks provided under General Construction; verify such axis lines and benchmarks.
- 2. Axis lines within building will be so spaced on each floor level that mechanical work may be laid out with tape measure having length of 50 feet maximum.
- 3. Benchmarks outside building will be at accessible points on building walls, from which lines and grades required for installation of mechanical and electrical work may be set.

B. Existing Services:

- Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect.
- 2. Inactive Services: When encountered in work, remove, cap, or plug inactive services.
- 3. Interruption of Services: Where work makes temporary shutdowns of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time required to make necessary connection to existing work.

C. Temporary Service and Lighting:

- 1. Maintain electrical service in operation to all portions of buildings at the construction site throughout construction. Provide temporary electrical service to all required areas of construction necessary to satisfy OSHA requirements.
- 2. Provide temporary lighting at a minimum of one 950-lumen (100-watt equivalent) lamp per 400 square feet of building area, or not less than one lamp per room of 150 square feet or more. Wiring and lamp holders shall meet all codes.
- 3. Provide temporary systems and remove before final acceptance of the work.
- 4. Pay metering, electrical service, and utility charges associated with temporary electrical service.

D. Existing Systems/Equipment

- 1. Electrical Distribution System: Verify existing components of the electrical distribution system are in good working order prior to de-energizing, and confirm that no issues are expected upon re-energizing. Verification shall include:
 - a. Visual inspection of panelboards, switchboards, feeders, and other distribution equipment associated with the scope of work.
 - b. Communication with facility maintenance staff to confirm pre-existing conditions.
 - c. Written communication to the Owner of findings. Owner reserves the right to confirm reported results prior to Contractor de-energizing and commencing renovation work.
- 2. Fire Alarm System: Verify existing equipment and components of the fire alarm system are in good working order prior to de-energizing or modifying. and confirm that no issues are expected upon re-energizing. Verification shall include:
 - a. Visual inspection of control panel, devices, cables, accessories, and connections.
 - b. Communication with facility maintenance staff to confirm pre-existing conditions.
 - c. Review of previous maintenance test results.
 - d. Written communications to the Owner of findings. Owner reserves the right to confirm reported results prior to Contractor de-energizing and commencing renovation work.
- E. Electrical Wiring and Equipment for Mechanical Systems

- 1. Division 26 installer shall provide:
 - a. Line Voltage and hook-up to all HVAC Equipment
 - b. All conduits into accessible attic space for thermostats and sensors.
 - c. All lighting contactors, mechanically held with control relay, required coil voltage coordinated with Division 23 controls installer.
 - d. Junction Boxes (Standard Two Gang) required for controls contactor, and coordination with Division 23 controls installer. One SPD power outlet at each energy management control panel located at Division 23 controls installer.
 - e. A weatherproof receptacle within 25 feet of each piece of mechanical equipment mounted either on the roof or on the ground. This receptacle shall be GFCI type, connected to the nearest 120/208 panelboard.
- 2. Division 23 installer shall provide:
 - a. All motor starters (with heaters as required).
 - b. All thermostats.
 - c. All HVAC Equipment.
 - d. All relays, contactors, and switches required to start/stop Mechanical Equipment other than switches shown on and required by Division 26.
- 3. Division 23 controls installer shall provide:
 - a. All required relays
 - b. All Sensors
 - c. All conduit required above ceiling.
 - d. All control wiring.
- 4. Electrical Drawings are based on the equipment and devices scheduled or called for in the specifications. Should any mechanical equipment or device associated devices be changed or accepted from those which are shown or noted, all electrical and mechanical changes shall be made at the expense of the trade initiating the change with no expense to Owner, Architect, Engineer, or their representatives.
- 5. Conduit and boxes for thermostats and sensors shall be provided by Division 26 installer. A thermostat or sensor junction box and 1/2" conduit to accessible attic and/or to corridor shall be provided for each room served with HVAC equipment. Coordinate with the mechanical drawings for exact locations and requirements. Control conduits required in attic, clear spaces, and on roof shall be by Division 23 installers. Details on Electrical drawings showing HVAC, mechanical, and control equipment providing of various relays devices, wiring, and other equipment shall be provided by Division 26 installer.
- F. Objectionable Noise and Vibration:
 - 1. Electrical equipment shall operate without objectionable noise or vibration.
 - 2. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building or other parts of Electrical work, make necessary changes and additions, as approved, without extra cost to Owner.
- G. Uniformity:
 - 1. Equipment and devices for communication, control, and alarm systems shall be products of a single manufacturer, for each system.
 - 2. Equipment and material of same type and classification shall be products of a single manufacturer and shall be interchangeable to the greatest extent possible.

1.12 PERMITS AND FEES

- A. Pay for building permits, and associated permit and inspection fees.
- B. Utility extensions and meter fees charged by the utility company for permanent services will be paid directly by the Owner. Where furnished by the utility company, costs associated with permanent metering equipment and its installation will be paid directly by the Owner.

1.13 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of products and materials specified, with a minimum five years of documented experience.
- B. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to the authority having jurisdiction.
- C. Materials furnished under this Contract shall be new and free from defects and shall be of the quality and design specified.
- D. Materials furnished under this Contract shall conform to applicable safety standards and shall be listed for their intended application and installation location.
- E. Equipment and accessories shall be standard products of a type that has been in satisfactory use for two (2) years. Major system components shall be of the same manufacturer and shall include manufacturer's nameplate stating address, catalog model number, and capacity.
- F. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, IEEE, and other applicable technical standards, and shall have neat and finished appearance.

1.14 DELIVERY, STORAGE, AND HANDLING

- Receive, inspect, handle, and store materials and equipment in accordance with manufacturer's instructions.
- B. Protect materials and equipment, using temporary shelters or approved offsite storage facilities, from damage, injury, theft, and contamination from dirt, dust, and moisture.
- C. Provide necessary supports, frames, and foundations to adequately support and protect materials and equipment, during storage, while transporting, and at final installation.
- Replace materials and equipment damaged prior to final acceptance, as directed by Architect.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.16 ASBESTOS ABATEMENT

A. In the event the Contractor encounters at the site material reasonably believed to be asbestos which has not been abated, the Contractor shall immediately stop work in the area affected and report the condition to the Owner. If in fact the material is asbestos and the asbestos has not been abated, the Contractor shall not resume the non-asbestos-related work in the affected area until the asbestos has been abated. The abatement action may be done in two ways, as the Owner may decide. The Owner may perform the abatement by its own forces, or the Owner may contract with a third party to perform the abatement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor shall be responsible for means and methods required to complete the work, including, but not limited to:
 - 1. Determine depth, routing, and exact location of existing underground utilities.

- 2. Relocate and repair existing underground utilities damaged during the work.
- 3. Maintain all utility services during the work to existing portion of the facility that are to remain.
- 4. Periodically clean, remove rubbish, and repair surfaces marred by the work.
- 5. Protect work from damage by other trades.
- 6. Erect barricades, protective fencing, and signs as required to prevent accidents, injuries, and theft.
- 7. Revise indicated equipment locations, device arrangements, and raceway and cable routing, as required to coordinate space and clearance requirements, securing approval of Architect through submission of Shop Drawings.
- 8. Accomplish all demolition and remodeling work involving his trade in a manner and completeness to provide the appearance of new construction work.
- 9. Replace equipment, materials, building finishes, and structure damaged during the work.
- B. Install materials and equipment in accordance with established standards, best practices for the type of work involved, and applicable technical societies' standards.
- C. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.
- D. Submit detailed Shop Drawings of supports, and obtain approval before fabricating or constructing.

3.02 CUTTING AND PATCHING

- A. Ensure sleeves are set at proper times to avoid delay of the Work. Cut walls, floors, partitions, and ceilings as required for the proper installation of the work in a neat and workmanlike manner, and as approved by the Architect.
- B. Joists, beams, girders, and columns shall not be cut without first obtaining written permission from Architect.
- C. Seal openings and conduit penetrations in fire-rated and smoke-rated assemblies:
 - 1. Ensure seals are made completely air tight.
 - 2. Sealing material shall be noncombustible and listed for the application.
 - 3. Provide materials and installation to ensure rating of assembly is not decreased.
 - 4. Provide materials and methods in accordance with NFPA standards, acceptable to Architect and authority having jurisdiction.
- D. Patch openings and alterations in interior walls, as approved by Architect, and prepare surfaces for accepting scheduled finish.
- E. Patch openings in exterior walls and seal to a watertight condition.

3.03 MANUFACTURER'S INSTRUCTIONS

- A. Equipment and devices shall be installed in accordance with Drawings and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions, obtain applicable manufacturer's instructions.
- C. Install products in accordance with manufacturer's written instructions.
- D. Contact manufacturer to request advice and supervisory assistance during the installation, when required to ensure proper and complete installation.

3.04 CIRCUITING

A. Maintain raceway systems serving systems of up to 150 volts to ground, separate from those serving systems of 151 to 600 volts to ground.

- B. Provide dedicated neutral conductors for branch circuits, except where multiwire branch circuits are specifically indicated to serve equipment or furniture, or where multipole branch circuits are utilized to serve equipment that does not require a neutral.
- C. Where multiwire branch circuits are specifically indicated to serve equipment or furniture, install in accordance with NEC 210.4.

3.05 INSTALLATION

- A. Coordinate installation of Division 26 work with the work of other trades to ensure systems are installed, complete, and functioning.
- B. Conduit and boxes, except mechanical controls specified otherwise, shall be provided by the Division 26 installer. Where permitted by specific specification section, low voltage wiring may be installed using open wiring methods in accessible attic space. Coordinate with, and verify with these specifications to provide required conduit and boxes at locations and heights required.
- C. Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings. Branch circuits may be installed in the slab. Install in slab as directed by Structural Engineer. Coordinate the actual electrical outlets and equipment with building features and mechanical equipment as indicated on architectural, structural and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of outlets before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.
- D. Conduits shall not be installed in structural walls, slabs, columns, beams, and other structural elements, except where permitted on Structural Drawings or written approval of Structural Engineer.
- E. Erect equipment in neat and workmanlike manner. Align, level, and adjust for satisfactory operation and so that all parts are easily accessible for inspection, operation, maintenance and repair.

3.06 SPACE REQUIREMENTS

- A. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated. Allow for adequate clearances as required by applicable codes, and for repair, maintenance, and replacement.
- B. Base equipment arrangements and clearance requirements on equipment Contractor intends to install, creating Shop Drawings and making note during submittal process of potential spatial conflicts.
- C. Final arrangements of equipment to be installed shall be subject to the Architect's review.
- D. Equipment Arrangements:
 - 1. Arrange equipment and conduit as shown in the Drawings, making minor rearrangements where necessary to suit the equipment approved, to comply with equipment manufacturer recommendations, and to fit the structural conditions.
 - 2. Provide Shop Drawings and obtain agreement of the Architect before proceeding with such rearrangements.
 - 3. Ensure that the combination of proposed equipment will fit into the allotted space shown on Drawings with adequate clearances for maintenance and servicing.
 - 4. Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department.
- E. Equipment that is too large to permit access through available stairways, doorways, shafts and windows along path to final location shall be delivered and set in place prior to constructing partitions that would create such obstructions.

3.07 RELATED ELECTRICAL PROVISIONS

- A. Electric control, motors, relays, thermostats, terminal, limiting switches, and similar devices and components on equipment shall be furnished as part of the equipment. Connections, controls, and interlocks to equipment shall be installed in accordance with Division 26 Drawings and specifications. Provide raceway system, conductors, control cabling, grounding, and disconnecting means as required for a complete system.
- B. Install connections required to systems of greater than 50 volts to ground, as part of the Division 26 work, even when associated equipment is furnished by another trade.
- C. Low voltage control, communication, and temperature control wiring shall be the responsibility of the trade installing the associated system.
 - 1. Where open wiring systems are permitted, trade installing each system shall provide appropriate supports dedicated to the specific system.
 - 2. Provide raceway systems where open wiring is not permitted, such as within walls, exposed in area subject to physical damage, and above areas with open ceilings.

3.08 TESTING

- A. During the progress of the work and upon completion, test systems as specified and as required by authorities having jurisdiction, Owner, and Architect. Test systems as part of Division 26 work. Provide services of qualified personnel, testing equipment, and apparatus.
- B. Test wiring systems to ensure they are free of short circuits and ground faults, and have insulation resistance from phase and neutral conductors to ground in accordance with ANSI and IEEE standards.
- C. Prior to the execution of testing, submit proposed test procedures recording forms, list of personnel, and test equipment to Architect for review.

3.09 CLOSE OUTS AND GUARANTEES

- A. Final Acceptance Review:
 - 1. Make a careful inspection of the entire project and ensure that the work is ready for final acceptance before contacting Architect to make final observation visit.
 - 2. Deliver to Architect all necessary bonds, warranties, receipts, affidavits, certifications of payment, and releases of liens, prepared and signed in advance, together with a letter of transmittal listing each paper included, at or before final observation visit. Verify that each document is consistent with requirements of the Contract Documents.
 - 3. The following will be required at time of final acceptance:
 - a. Final clean-up completed.
 - b. Systems are fully operational; material and devices installed and tested.
 - c. Ground tests (megger readings) performed and documented with two (2) copies of method used and results attached.
 - d. Project Record Documents.

B. Training:

- 1. Upon completion of the work and at a time designated by Architect, provide formal training session for the Owner's operating personnel.
- 2. Training session shall include instruction on proper operation and maintenance of electrical equipment and systems and shall identify location of components.
- 3. In addition to time requirements of specific sections, provide 4-hour training session.

C. Adjustments:

- 1. Adjust equipment and devices and run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications.
- 2. If equipment does not function satisfactorily after the first adjustments are made, continue the work until satisfactory corrections and adjustments have been made.
- 3. Ensure proper performance, functioning, integration, and balance of equipment.

- 4. Where tests are required by Architect to ascertain equipment capacities in the installed condition, run approved tests, provide required instruments and apparatus, and submit certified statements of test results.
- 5. Ensure instruments are in proper calibration and meet approval of Architect.

D. Completeness:

- 1. Ensure absolute completeness of the work, including adjustments, balancing, testing, and commissioning; and ensure proper operation in all respects.
- 2. Install systems complete and functional in all respects, including installation of such items as trim, fittings, cabling, and accessories.
- 3. Protect the work from damage. Provide required temporary shelters to adequately protect apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- 4. Replace equipment and rework installation, where equipment has been damaged during the course of the project.
- E. Cleaning: Equipment shall be thoroughly cleaned and degreased, cuttings and other foreign substances.

F. Warranty:

- Guarantee work, equipment, and materials for a period of one (1) year from date of substantial completion acceptance. Defects in labor and materials occurring during this period shall be immediately repaired or replaced by Contractor at no additional cost to the Owner
- 2. Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.
- 3. Neither the final payment nor any provisions in Contract Documents shall relieve Contractor of the responsibility for faulty materials or workmanship.
- 4. Remedy any defects due faulty materials and workmanship and pay for damage to other work resulting therefrom.
- 5. Owner shall give notice of observed defects with reasonable promptness.

END OF SECTION 26 05 00

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes building wire and cable; metal clad cable; and wiring connectors and connections. Armored Cable (Type AC) is not permitted for any installations as part of this specification.
- B. Related Sections:
 - Section 26 05 53 Identification for Electrical Systems: Product requirements for wire identification.

1.02 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.03 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Conductors #10 AWG and smaller shall be solid. Conductors #8 AWG and larger shall be stranded.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than #12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than #14 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
 - 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
 - 3. Wet or Damp Interior Locations: Use only building wire, Type XHHW insulation, in raceway.
 - 4. Exterior Locations: Use only building wire, Type XHHW insulation, in raceway.
- C. Conductors shall be installed as single conductor building wire installed in raceway systems, except that Type MC cable may be installed as follows:
 - 1. For final connections to light fixtures, in lengths not to exceed 6 feet.
 - For final connections to vibration producing equipment in dry locations, in lengths not to exceed 6 feet.
 - 3. For horizontal cabling concealed within walls, except that homeruns shall be single conductor building wire installed in raceway systems.
- D. Type AC cables shall not be permitted.

1.04 DESIGN REQUIREMENTS

A. Conductor sizes are based on copper.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Submit for building wire and each cable assembly type.
- B. Design Data:
 - Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- C. Test Reports:
 - 1. Indicate procedures and values obtained.

1.06 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 - 1. Record actual locations of components and circuits.

1.07 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

1.08 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.09 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destination are indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Manufacturers:
 - 1. AETNA
 - 2. American Insulated Wire Corp.
 - 3. Colonial Wire
 - 4. Encore Wire
 - 5. General Cable Co.
 - 6. Republic Wire
 - 7. Rome Cable
 - 8. Service Wire Co.
 - 9. Southwire
 - 10. Superior Essex
 - 11. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 90 degrees C.

F. Insulation Material: Thermoplastic.

2.02 METAL CLAD (MC) CABLE

- A. Manufacturers:
 - 1. AFC Cable
 - 2. Southwire
 - 3. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Multiconductor cable, insulated wire. Galvanized, interlocking steel cover.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 90 degrees C.
- F. Insulation Material: Thermoplastic.
- G. Exterior jacket shall be painted for ready identification of conductor size and quantity and special listings.

2.03 TERMINATIONS

- A. Terminal Lugs for Wires #6 AWG and Smaller:
 - 1. Solderless, compression type copper.
- B. Lugs for Wires #4 AWG and Larger:
 - 1. Color keyed compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.04 INSTALLATION

A. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

- B. Route wire and cable to meet Project conditions.
- C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- D. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- E. Minimum Conductor Size Building Wire in Raceway:
 - 1. Minimum #14 AWG for control circuits.
 - 2. Minimum #10 AWG for power homeruns.
 - 3. Minimum #10 AWG for special outlets, dedicated outlets, and hard-wired connections to equipment.
 - 4. Minimum #10 AWG for 20-ampere, 120- and 277-volt branch circuits. The backbone of all 20-ampere lighting and power branch circuits shall be #10 AWG. Drops to individual receptacles and light fixtures may be #12 AWG.
- F. Special Techniques Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire #4 AWG and larger with pulling equipment and lubricant.
- G. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- H. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, #6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, #10 AWG and smaller.
- I. Special Techniques Type MC Cable:
 - 1. Install per manufacturer's instructions, in accordance with local amendments as adopted by the AHJ.
 - 2. Route perpendicular to building lines and be installed in a workmanlike manner.
 - 3. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 4. Use suitable cable fittings and connectors.
- J. Where permitted for use, install Type MC cable in accordance with NEC Article 330.
- K. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- L. Install terminal lugs on ends of 600-volt wires unless lugs are furnished on connected device, such as circuit breakers.
- M. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires #4 AWG and larger to copper bus bars.
- N. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.05 WIRE COLOR

- A. <u>Phase Conductors, including Switch Legs</u> Color code conductors as indicated in the Wire Color Code Table below.
 - 1. For wire sizes #6 AWG and smaller, install wire with insulation color per the table.
 - 2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify wire with colored tape at terminals, splices and boxes, with color per the table.
- B. Neutral Conductors Color code conductors as indicated in the Wire Color Code Table below. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
 - 1. For wire sizes #6 AWG and smaller, install wire with insulation color per the table.
 - 2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify wire with colored tape at terminals, splices and boxes, with color per the table.
- C. Ground Conductors Color code conductors as indicated in the Wire Color Code Table below.
 - 1. For wire sizes #6 AWG and smaller, install wire with insulation table per table.
 - 2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify with colored tape at terminals, splices and boxes, with color code per the table.

WIRE COLOR CODE TABLE				
Phase Conductor	480Y/277 3 Phase	208Y/120 3 Phase	120/240V 1 Phase	240/120V, Delta, 3 Phase
A or L1	Brown	Black	Black	Black
B or L2	Yellow	Red	Red	Orange (High Leg)
C or L3	Purple	Blue		Blue
Neutral	Gray with Tracer to Match Phase Color	White with Tracer to Match Phase Color	White with Tracer to Match Phase Color	White with Tracer to Match Phase Color
Ground	Green	Green	Green	Green
Isolated Ground		Green with Yellow Tracer	Green with Yellow Tracer	Green with Yellow Tracer
Switch Leg	Pink, marked with tape in Same Color as Phase Conductor, where applicable.			

3.06 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 05 19

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Grounding well components.
 - 5. Ground Bars.
 - 6. Mechanical connectors.
 - 7. Exothermic connections.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.

1.03 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Submit data on grounding electrodes and connections.
- B. Test Reports:
 - 1. Indicate overall resistance to ground and resistance of each electrode.
- C. Manufacturer's Certificate:
 - 1. Certify Products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.06 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.07 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer:
 - 1. Company specializing in performing work of this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multipleuse materials to quantities needed for immediate installation.

1.09 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.01 ROD ELECTRODES

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. O-Z Gedney Co.
 - 3. Thomas & Betts, Electrical.
 - 4. Substitutions: Section 01 60 00 Product Requirements Not Permitted.
- B. Product Description:
 - 1. Material: Copper-clad steel Copper.
 - 2. Diameter: ³/₄ inch.
 - 3. Length: 10 feet.

2.02 ACTIVE ELECTRODES

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. O-Z Gedney Co.
 - 3. Thomas & Betts, Electrical.
 - 4. Substitutions: Section 01 60 00 Product Requirements Not Permitted.
- B. Product Description:
 - 1. Material: Metallic-salt-filled copper-tube electrode.
 - 2. Shape: Straight. L-shaped. As indicated on Drawings.
 - 3. Length: 10 feet.
 - 4. Connector: Connector exothermic welded connection. U-bolt clamp.

2.03 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare insulated.
- D. Bonding Conductor: Copper conductor bare insulated.

2.04 GROUNDING WELL COMPONENTS

- A. Well Pipe:
 - 1. 8 inches NPS by 24 inches long clay tile concrete fiberglass pipe with belled end.
- B. Well Cover:
 - 1. Cast iron Fiberglass with legend "GROUND" embossed on cover.

2.05 GROUND BARS

- A. Manufacturers:
 - 1. Chatsworth Products.
 - 2. Erico, Inc.; Caddy.
 - 3. Storm Power Products.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Electrical Room Ground Bars: Copper ground busbar, 4" H by 20" W by 1/4" D, with insulated standoff for wall mounting and standard hole pattern for power system grounding; Chatsworth #10622-020 or approved equal.
- C. MDF and IDF Room Ground Bars: Copper ground busbar, 4" H by 12" W by 1/4" D, with insulated standoff for wall mounting and TMGB-style hole pattern for telecom system grounding; Chatsworth #40153-012 or approved equal.

2.06 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. ILSCO Corporation.
 - 3. O-Z Gedney Co.
 - 4. Thomas & Betts, Electrical.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Description:
 - 1. Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.07 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Copperweld, Inc.
 - 2. ILSCO Corporation.
 - 3. O-Z Gedney Co.
 - 4. Thomas & Betts, Electrical.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.01 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.02 PREPARATION

A. Remove surface contaminants at connection points.

3.03 INSTALLATION

- A. Install in accordance with IEEE 142 or 1100.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding well pipe with cover at each rod location, as indicated on Drawings. Install well pipe top flush with finished grade.

- E. Install grounding electrode conductor and connect to reinforcing steel in foundation footings as indicated on Drawings. Electrically bond steel together.
- F. Equipment Grounding Conductor:
 - 1. Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- G. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- H. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed grounding conductor to grounding bus.
- J. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- K. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.04 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground resistance testing in accordance with IEEE 142.
- E. Perform continuity testing in accordance with IEEE 142.
- F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 26 05 26

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete: Product requirements for concrete for placement by this section.

1.02 REFERENCES

- A. ASTM International:
 - ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH Certification Listings.

1.03 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System):
 - Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SYSTEM DESCRIPTION

- A. Firestopping Materials:
 - 1. UL 1479, to achieve fire ratings of adjacent construction in accordance with FM.
- B. Surface Burning:
 - 1. UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS

- A. Firestopping:
 - Conform to applicable code FM for fire resistance ratings and surface burning characteristics.
 - Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate system layout with location and detail of trapeze hangers.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Firestopping Schedule:
 - 1. Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Design Data
 - 1. Indicate load carrying capacity of trapeze hangers and hangers and supports.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate:
 - 1. Certify products meet or exceed specified requirements.

1.07 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 3. Floor Penetrations within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies:
 - 1. Materials to resist free passage of flame and products of combustion.
 - 2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies:
 - 1. UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints between Floor Slabs and Exterior Walls:
 - 1. ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics:
 - 1. 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.08 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer:
 - 1. Company specializing in performing work of this section with minimum three years documented experience.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.01 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
 - B. Hanger Rods:
 - 1. Threaded high tensile strength galvanized carbon steel with free running threads.
 - C. Beam Clamps:
 - 1. Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
 - D. Conduit clamps for trapeze hangers:
 - 1. Galvanized steel, notched to fit trapeze with single bolt to tighten.
 - E. Conduit clamps general purpose: One hole malleable iron for surface mounted conduits.
 - F. Cable Ties:
 - 1. High strength nylon temperature rated to 185 degrees F. Self locking.

2.02 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Kindorf.

- 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.03 SLEEVES

- A. Sleeves through Non-fire Rated Floors:
 - 1. 18 gage thick galvanized steel.
- B. Sleeves through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors:
 - 1. Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing:
 - 1. Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation:
 - 1. Glass fiber type, non-combustible.

2.04 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.05 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Specified Technology, Inc.
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 2. Silicone Firestopping Elastomeric Firestopping: Silicone elastomeric compound and compatible silicone sealant.
 - 3. Foam Firestopping Compounds: Single.
 - 4. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 5. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 6. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 7. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 8. Firestop Pillows: Formed mineral fiber pillows.

2.06 FIRESTOPPING ACCESSORIES

A. Primer:

1. Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories:

1. Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

- 1. Furnish UL listed products.
- 2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces

- 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
- 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- Do not drill or cut structural members.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.

B. Inserts:

- 1. Install inserts for placement in concrete forms.
- 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

- 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- 5. Where inserts are omitted, drill through concrete slab from below and provide throughbolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.

F. Supports:

- 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
- 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
- 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
- 4. Support vertical conduit at every other floor.

3.04 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- F. Place intumescent coating in sufficient coats to achieve rating required.
- G. Remove dam material after firestopping material has cured.
- H. Fire Rated Surface:
 - 1. Seal opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway, and trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:

- 1. Seal opening through non-fire rated surface as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
- 2. Install escutcheons or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.06 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.07 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.08 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.09 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 05 29

SECTION 26 0533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 34 Floor Boxes for Electrical Systems.
 - 4. Section 26 05 53 Identification for Electrical Systems.
 - 5. Section 26 27 26 Wiring Devices.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Electric Rigid Steel Conduit.
 - 2. ANSI C80.3 Electrical Metallic Tubing Steel (EMT-S).
 - 3. ANSI C80.5 Electrical Rigid Metal Conduit Aluminum (ERMC-A).
 - 4. ANSI C80.6 Electrical Intermediate Metal Conduit.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 3. NEMA FB 2.10 Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (RMC, IMC, and EMT).
 - 4. NEMA FB 2.20 Selection and Installation Guidelines Fittings for Use with Flexible Electrical Conduit and Cable.
 - 5. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 6. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 7. NEMA RN 1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.
 - 8. NEMA RV 3 Application and Installation Guidelines for Flexible and Liquidtight Flexible Metal and Nonmetallic Conduits.
 - 9. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 10. NEMA TC 3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

1.03 SUBMITTALS

- A. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Raceway fittings.
 - 5. Conduit bodies.
 - 6. Wireway.
 - 7. Pull and junction boxes.
- B. Manufacturer's Installation Instructions:
 - 1. Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.06 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.07 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Conduit Size:
 - 1. 3/4-inch minimum unless otherwise indicated.
 - 2. 1-inch minimum for underground conduits, unless otherwise indicated.

1.08 CONDUIT REQUIREMENTS

- A. Outdoor Locations, Above Grade:
 - 1. RMC or IMC.
 - 2. Enclosures: Painted steel or stainless steel; NEMA 3R, 4, or 4X listed.
 - 3. Outlet Boxes: Cast metal outlet and junction boxes.
- B. Underground Conduits, direct buried, encased in flowable or in concrete:
 - 1. Within five feet from foundation, RMC or IMC.
 - 2. More than five feet from foundation, RMC, IMC, or PVC.
 - 3. Where PVC conduit is used:
 - a. Transition to RMC or IMC conduit for changes of direction, for turn ups, and where emerging from grade or concrete.
 - b. Use Schedule 80 PVC where routed below drivable surfaces, except where encased in concrete.
 - 4. Where RMC or IMC is used:
 - a. Wrap or coat conduit to prevent corrosion where installed in contact with concrete, soil, or flowable fill.
 - 5. Enclosures: Provide cast metal outlet, pull, and junction boxes. Provide in-ground pullboxes, handholes, and manholes where indicated in the Drawings.
- C. Within Concrete Slabs and Structural Members:
 - 1. RMC. IMC. or PVC.
 - 2. Maximum Conduit Size: 1-1/2" nominal.
 - 3. Where Permitted:
 - a. Only permitted where required to serve floor boxes or islands,

- b. Proposed locations and routing of conduits within concrete slabs and structural members must be submitted to Structural Engineer for review and approval prior to installation.
- D. Interior Wet and Damp Locations:
 - 1. RMC or IMC
 - 2. Enclosures: Painted steel or stainless steel; NEMA 3R, 4, or 4X listed.
 - 3. Outlet Boxes: Cast metal outlet and junction boxes; flush mounted in finished areas.
- E. Interior Dry Locations, Concealed:
 - 1. Branch Circuits: EMT, RMC, or IMC.
 - 2. Feeders: EMT, RMC, or IMC.
 - 3. Enclosures: Steel or stainless steel; NEMA 1 listed. Include hinges on enclosures with any single dimension larger than 24 inches.
 - 4. Outlet Boxes: Sheet-metal boxes; flush mount in finished areas.
- F. Interior Dry Locations, Exposed:
 - 1. Branch Circuits: EMT, RMC, IMC, except as noted below:
 - Less than 10 feet above finished floor in mechanical rooms, electrical rooms, gymnasiums, warehouses, and similar areas subject to physical damage, use only RMC or IMC.
 - 2. Feeders: EMT, RMC, or IMC.
 - 3. Enclosures: Steel or stainless steel; NEMA 1 listed. Include hinges on enclosures with any single dimension larger than 24 inches.
 - 4. Outlet Boxes: Sheet-metal boxes; flush mount in finished areas.
- G. Equipment Connections:
 - 1. FMC or LFMC.
 - 2. Maximum Length: 60 inches.

PART 2 - PRODUCTS

2.01 RIGID METAL CONDUIT (RMC) AND INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 - 1. AFC Cable
 - 2. Alflex
 - 3. Allied Tube & Conduit
 - 4. Anamet Electrical
 - 5. Electri-Flex
 - 6. Manhattan/CDT
 - 7. Maverick Tube
 - 8. O-Z Gedney
 - 9. Wheatland Tube
 - 10. Substitutions: Section 01 60 00 Product Requirements.
- B. RMC: Galvanized steel, except where otherwise indicated.
- C. Galvanized Steel Rigid Conduit (GRC): ANSI C80.1.
- D. Aluminum Rigid Conduit (ARC): ANSI C80.5.
- E. IMC: Galvanized steel, except where otherwise indicated; ANSI C80.6.
- F. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.02 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable
 - 2. Alflex
 - 3. Allied Tube & Conduit

- 4. Anamet Electrical
- 5. Electri-Flex
- 6. Manhattan/CDT
- 7. Maverick Tube
- 8. O-Z Gedney
- 9. Wheatland Tube
- 10. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Interlocked steel construction.
- C. Fittings: NEMA FB 1.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable
 - 2. Alflex
 - 3. Allied Tube & Conduit
 - 4. Anamet Electrical
 - 5. Electri-Flex
 - 6. Manhattan/CDT
 - 7. Maverick Tube
 - 8. O-Z Gedney
 - 9. Wheatland Tube
 - 10. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.04 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. AFC Cable
 - 2. Alflex
 - 3. Allied Tube & Conduit
 - 4. Anamet Electrical
 - 5. Electri-Flex
 - 6. Manhattan/CDT
 - 7. Maverick Tube
 - 8. O-Z Gedney
 - 9. Wheatland Tube
 - 10. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies:
 - 1. NEMA FB 1; steel, compression set screw type.

2.05 PVC CONDUIT

- A. Manufacturers:
 - 1. Carlon Electric Products
 - 2. Ethyl Corp.
 - 3. Can-Tex Industries
 - 4. Condux
- B. Product Description:

- 1. NEMA TC 2, PVC Tubing and Conduit.
- C. Fittings:
 - 1. NEMA TC 3, PVC fittings for use with rigid PVC Conduit and Tubing.

2.06 OUTLET BOXES

- A. Manufacturers:
 - 1. Cooper
 - 2. Appleton
 - 3. Erickson
 - 4. Haffman
 - 5. Hubbell
 - 6. O-Z/Gedney
 - 7. Thomas & Belts
 - 8. Walker
 - 9. The Wiremold Co.
 - 10. Substitutions: Section 01 60 00 Product Requirements.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2-inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes:
 - 1. NEMA FB 1, Type FD, cast ferroalloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas:
 - 1. As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas:
 - 1. Furnish gasketed cover.

2.07 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Sheet Metal Boxes:
 - 1. NEMA OS 1, galvanized steel.
- C. Surface Mounted Cast Metal Box:
 - 1. NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - a. Material: Galvanized cast iron.
 - b. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.
- D. In-Ground Cast Metal Box:
 - 1. NEMA 250,
 - a. Type 6, inside flanged, recessed cover box for flush mounting:
 - 1) Material: Galvanized cast iron.
 - 2) Cover: Nonskid cover with neoprene gasket and stainless-steel cover screws.
 - 3) Cover Legend: "ELECTRIC".

- E. Concrete composite Handholes:
 - 1. Die-molded, glass-fiber concrete composite hand holes:
 - a. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
 - b. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.03 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.04 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Maintain clearance between raceway and piping for maintenance purposes.

- K. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- L. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- M. Bring conduit to shoulder of fittings; fasten securely.
- N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- O. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- P. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.
- Q. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- R. Install fittings to accommodate expansion and deflection where raceway crosses seismic control and expansion joints.
- S. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- T. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- U. Close ends and unused openings in wireway.

3.05 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.06 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified.
- C. Locate outlet boxes to allow luminaires positioned as indicated on lighting plan.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.07 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.08 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION 26 05 33

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Wire markers.
 - 3. Underground Warning Tape.
 - 4. Lockout Devices.
- B. Related Sections:
 - 1. Section 09 9000 Painting and Coating: Execution requirements for painting specified by this section.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- B. Manufacturer's Installation Instructions:
 - 1. Indicate installation instructions, special procedures, and installation.

1.03 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 - 1. Record actual locations of tagged devices; include tag numbers.

1.04 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer:
 - 1. Company specializing in performing Work of this section with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 ENVIRONMENTAL REQUIREMENTS

- Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Product Description:
 - 1. Laminated three-layer plastic with engraved white letters on black contrasting background color.
- B. Letter Size (Switchboards):
 - 1. 1/2-inch-high letters for identifying individual equipment.
 - 2. 1/4-inch-high letters for identifying miscellaneous information.
 - 3. Refer to details for additional information.
- C. Letter Size (Panelboards, Transformers, Disconnects, etc.):
 - 1. 1/4-inch-high letters for identifying individual equipment.
 - 2. 1/8-inch-high letters for identifying miscellaneous information.
 - 3. Refer to details for additional information.
- D. Minimum nameplate thickness: 1/8 inch.
- E. Mounting Method: Corrosion Resistant Rivets

2.02 WIRE MARKERS

- A. Description:
 - 1. Split sleeve or tubing type wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

2.03 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Marking Services, Inc.; or Equal.
- B. Description:
 - Detectable, 3-inch-wide solid aluminum foil core tape, colored red with suitable warning legend describing buried electrical lines. Tape shall have black letters stating "CAUTION BURIED ELECTRIC LINE BELOW."

2.04 LOCKOUT DEVICES

A. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant screw, rivets or with bolt and nut.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant screws, rivets or with bolt and nut.
 - 4. Secure nameplate to equipment front using corrosive-resistant screws, rivets or with bolt and nut.

- 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
- 6. Install nameplates for the following:
 - a. Panelboards.
 - b. Service Disconnects.
 - c. Motor Starters and Motor Control Devices.
 - d. Lighting Contactors and Time Switches.
- 7. Name plate requirements as indicated in table below:

EQUIPMENT	SIZE LETTERING	INFORMATION
PANELBOARDS	1/4" / 1/8"	
Name/Ratings	1/4" / 1/8"	Panelboard designation/ampere rating and voltage characteristics <u>EX</u> : 1LB3
SAFETY SWITCHES	1/8"	Load served and circuit number <u>EX:</u> ELEVATOR NO. 1 CKT 1LB3 – 37,39,41
MOTOR STARTERS	1/8"	Load served and circuit number <u>EX:</u> AHU-1 CKT 1LB3 – 38, 40, 42
MOTOR CONTROL DEVICES	1/8"	Load served <u>EX:</u> AHU-2
TIME SWITCHES OR CONTACTORS	1/8"	Load served <u>EX:</u> Exterior Lights

C. Wire Marker Installation:

- 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and each load connection.
- 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
- 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
- D. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 26 05 53

SECTION 26 2416 PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes distribution and branch circuit panelboards.
- B. Related Sections:
 - 1. Section 26 0526 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 0553 Identification for Electrical Systems.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 4. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 5. NEMA PB 1 Panelboards.
 - 6. NEMA PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 Safety for Panelboards.
 - 2. UL 1283 Electromagnetic Interference Filters.
 - 3. UL 1449 Transient Voltage Surge Suppressors.

1.03 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Product Data:
 - 1. Submit catalog data showing specified features of standard products.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 7000 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 - 1. Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data:
 - 1. Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.06 MAINTENANCE MATERIALS

- Section 01 7000 Execution and Closeout Requirements: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

PART 2 - PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. ABB; GE Industrial Solutions.
 - 2. Eaton Corporation; Cutler Hammer.
 - 3. Schneider Electric; Square D.
 - 4. Siemens Industry.
 - 5. Substitutions: Section 01 6000 Product Requirements.
 - B. Product Description:
 - 1. NEMA PB 1, circuit breaker type panelboard.
 - C. Panelboard Bus:
 - 1. Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
 - D. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards. Panelboards shall be fully rated.
 - E. Molded Case Circuit Breakers:
 - 1. NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - F. Circuit Breaker Accessories:
 - 1. Trip units and auxiliary switches as indicated on Drawings.
 - G. Enclosure: NEMA PB 1, Type 1.
 - H. Cabinet Front:
 - 1. Surface type, fastened with hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.02 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. ABB; GE Industrial Solutions.
 - 2. Eaton Corporation; Cutler Hammer.
 - 3. Schneider Electric; Square D.
 - 4. Siemens Industry.
 - 5. Substitutions: Section 01 6000 Product Requirements.
- B. Product Description:
 - 1. NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

- C. Panelboard Bus:
 - 1. Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard including insulated ground bus as indicated on Drawings.
- D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral, where indicated on the electrical drawings.
- E. Minimum Integrated Short Circuit Rating; 10,000 amperes rms symmetrical for 240-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards or as indicated.
- F. Molded Case Circuit Breakers:
 - NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1.
- H. Cabinet Box: 6 inches deep, 20 inches wide.
- I. Cabinet Front:
 - 1. Flush cabinet front, door-in-door, with concealed trim clamps, concealed hinge, metal directory frame and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Section 26 0553.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty, 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 0526. Connect equipment ground bars of panels in accordance with NFPA 70.

3.02 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.03 ADJUSTING

- A. Section 01 7000 Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 26 2416

SECTIONS 26 27 26 WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes commercial-grade standard, GFCI, and twist-locking receptacles; cord and plug sets; toggle switches; occupancy sensors, timer switches, and wall-box dimmers; floor service fittings; and wall plates.

1.02 REFERENCES

- A. National Electrical Contractors Association (NECA) Standards
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA WD1 General Color Requirements for Wiring Devices
 - 2. NEMA WD6 Wiring Devices Dimensional Specifications
 - 3. Wiring Device Configurations (e.g. NEMA L5-20R)
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code
- D. UL Standards
- E. Federal Specification Standards

1.03 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.04 SUBMITTALS FOR REVIEW

- A. Product Data: For each type of product, provide manufacturer's catalog information, showing dimensions, colors, and configurations.
- B. Samples: One for each type of device and wall plate specified, in each color specified.
- C. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- D. Close Out Documentation:
 - 1. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Acceptable Manufacturers: Products meeting the specification and Basis of Design, from the following manufacturers will be considered acceptable:
 - 1. Eaton Wiring Devices (formerly Cooper Wiring Devices).
 - 2. Hubbell Wiring Devices-Kellems.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Pass & Seymour; Legrand North America.
- B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Comply with NFPA 70.
- D. RoHS compliant.
- E. Comply with NEMA WD 1.
- F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- G. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- H. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Where a blank character "_" is included in a Basis of Design part number, letter(s) are intended to be substituted to identify color.
- I. Wall Plate Color: For plastic and painted covers, match device color.
- J. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #5352A_; Hubbell #BR20_.
 - 2. Description: Two pole, three wire, and self-grounding.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Standards: Comply with UL 498 and FS W-C-596.
- B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #IG5352_.
 - 2. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Standards: Comply with UL 498 and FS W-C-596.
- C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #BR20 TR.
 - 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.

- 4. Standards: Comply with UL 498 and FS W-C-596.
- 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #BR20_WR.
 - 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Standards: Comply with UL 498.
 - 5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #BR20_WRTR.
 - 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Standards: Comply with UL 498.
 - 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.03 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #GFR5362SG; Hubbell #GFRST20.
 - 2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding.
 - 3. Configuration: NEMA WD 6. Configuration 5-20R.
 - 4. Type: Feed through.
 - 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #GFTRST20_.
 - 2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.
 - 4. Type: Feed through.
 - 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
 - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #GFTWRST20 .
 - 2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 3. Configuration: NEMA WD 6, Configuration 5-15R.
 - 4. Type: Feed through.
 - 5. Standards: Comply with UL 498 and UL 943 Class A.
 - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.04 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Receptacles, 120 V, 20 A:
 - 1. Basis of Design: Hubbell #HBL2310.
 - 2. Configuration: NEMA WD 6, Configuration L5-20R.

- 3. Standards: Comply with UL 498.
- B. Twist-Lock, Single Receptacles, 250 V, 20 A:
 - 1. Basis of Design: Hubbell #HBL2320.
 - 2. Configuration: NEMA WD 6, Configuration L6-20R.
 - 3. Standards: Comply with UL 498.
- C. Twist-Lock, Single Receptacles, 277 V, 20 A:
 - 1. Basis of Design: Hubbell #HBL2330.
 - 2. Configuration: NEMA WD 6, Configuration L7-20R.
 - 3. Standards: Comply with UL 498.
- D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A:
 - 1. Basis of Design: Hubbell #IG2310.
 - Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
 - 3. Configuration: NEMA WD 6, Configuration L5-20R.
 - 4. Standards: Comply with UL 498.
- E. Twist-Lock, Isolated-Ground, Single Receptacles, 250 V, 20 A:
 - 1. Basis of Design: Hubbell #IG2320.
 - Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
 - 3. Configuration: NEMA WD 6, Configuration L6-20R.
 - 4. Standards: Comply with UL 498.

2.05 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.06 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 - 1. Basis of Design: Hubbell #CSB120_.
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- B. Two-Pole Switches, 120/277 V. 20 A:
 - 1. Basis of Design: Hubbell #CSB220 .
 - 2. Comply with UL 20 and FS W-S-896.
- C. Three-Way Switches, 120/277 V, 20 A:
 - 1. Basis of Design: Hubbell #CSB320 .
 - 2. Comply with UL 20 and FS W-S-896.
- D. Four-Way Switches, 120/277 V, 20 A:
 - 1. Basis of Design: Hubbell #CSB420
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 - 1. Basis of Design: Hubbell #HBL1556_.
 - 2. Description: For use with mechanically held lighting contactors.

3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.07 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology:
 - 1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
 - 2. Standards: Comply with UL 20.
 - 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 4. Adjustable time delay of 20 minutes.
 - 5. Able to be locked to Automatic- and Manual-On modes.
 - 6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 - 7. Connections: Provisions for connection to BAS.
 - 8. Connections: RJ-45 communications outlet.
 - 9. Connections: Integral wireless networking.
- B. Wall Sensor Light Switch, Passive Infrared:
 - 1. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
 - 2. Standards: Comply with UL 20.
 - 3. Connections: Provisions for connection to BAS.
 - 4. Connections: Hard wired.
 - 5. Connections: Wireless.
 - 6. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 7. Integral relay for connection to BAS.
 - 8. Adjustable time delay of 20 minutes.
 - 9. Able to be locked to Automatic- and Manual-On modes.
 - 10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
- C. Wall Sensor Light Switch, Ultrasonic:
 - 1. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
 - 2. Standards: Comply with UL 20.
 - 3. Connections: Provisions for connection to BAS.
 - 4. Connections: RJ-45 communications outlet.
 - 5. Connections: Integral wireless networking.
 - 6. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 7. Integral relay for connection to BAS.
 - 8. Adjustable time delay of 20 minutes.
 - 9. Able to be locked to Automatic- and Manual-On modes.
 - 10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.08 TIMER LIGHT SWITCH

- A. Digital Timer Light Switch:
 - 1. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 20-minute increments.
 - 2. Standards: Comply with UL 20.
 - 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 - 4. Integral relay for connection to BAS.

2.09 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

- B. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

- A. Basis of Design: As indicated on Drawings.
- B. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
- C. Compartments: Barrier separates power from voice and data communication cabling.
- D. Service Plate and Cover: Rectangular, die-cast aluminum with satin finish.
- E. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- F. Data Communication Outlet: Coordinate with Division 27 installer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA "Standard of Installation", unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

- 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
- 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
- 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:

- 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
- 5. Connect ground terminals of wiring devices to grounded box using equipment bonding jumper, except as allowed by NEC for isolated ground receptacles.
- 6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

- 7. Use a torque screwdriver when a torque is recommended or required by manufacturer.
- 8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 9. Tighten unused terminal screws on the device.
- 10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

 Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Switch Orientation:

- 1. For single-throw switches, install switches vertically, with the load on when the handle is in the on position.
- 2. For three-way and four-way switches, install switches vertically, with the load off when the handle of all devices on the control circuit are in the down position.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:

- 1. Install dimmers within terms of their listing.
- 2. Verify that dimmers used for fan-speed control are listed for that application.
- 3. Do not share neutral conductors on the load side of dimmers.
- 4. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
- I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates. Mount device and wall plates level and plumb.
- J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 MOUNTING HEIGHT AND COORDINATION

- A. Coordinate installation of wiring devices with furniture and millwork prior to commencing device rough-in to avoid conflicts.
- B. Install the following devices at 44 inches above finished floor to the bottom of the box, except where otherwise noted:
 - 1. Switches.
 - 2. Dimmers.
- C. Install the following devices at 18 inches above finished floor to the bottom of the box, except where otherwise noted:
 - 1. Receptacles.
 - 2. Telephone and Communications Outlets.
- D. Where the following devices are designated "AC" (above counter), install at 3 inches above the back splash to the bottom of the box and mount horizontally:
 - 1. Receptacles.
 - 2. Telephone and Communications Outlets.
- E. Telephone outlets for wall mounted phones shall be located such that the top of the telephone is located as follows:
 - 1. Forward-Reach Locations: 44 inches above finished floor.
 - 2. Side-Reach Locations: 54 inches above finished floor.

3.03 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

- B. Identify each receptacle with panelboard identification and circuit number, using approved label maker.
- C. Identify switches and control devices to identify load served, except where up to two switches are used to control lighting within the space.

3.04 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions. Remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Tests for Switches and Dimmers:
 - 1. Operate each switch and dimmer to verify proper operation of control device and lighting equipment.
 - 2. Where portions of a lighting circuit are to remain energized, such as for emergency ballasts and night lights, verify correct operation.
- F. Cleaning and Adjustment:
 - 1. Adjust devices and wall plates to be flush and level.
 - 2. Adjust floor outlets to ensure covers and flanges are tight to floor with minimum impact to pedestrian traffic.
 - 3. Clean exposed surfaces to remove splatters and restore finishes.
- G. Wiring device will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 2819 ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes fusible and non-fusible switches.
- B. Related Sections:
 - 1. Section 26 2813 Fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Submit switch ratings and enclosure dimensions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual locations of enclosed switches and ratings of installed fuses.

1.05 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. ABB; GE Industrial Solutions.
 - 2. Eaton Corporation; Cutler Hammer.
 - 3. Schneider Electric; Square D.
 - 4. Siemens Industry.
 - 5. Substitutions: Section 01 6000 Product Requirements.
- B. Product Description:
 - 1. NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips:
 - 1. Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure:
 - 1. NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 2. Interior Dry Locations: Type 1.
 - 3. Exterior Locations: Type 3R.

- 4. Industrial Locations: Type 4 or 4X as indicated on drawings.
- E. Service Entrance:
 - 1. Switches identified for use as service equipment are to be labeled for this application. Furnish short circuit and overcurrent protective devices in enclosed assembly, with solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.02 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. ABB; GE Industrial Solutions.
 - 2. Eaton Corporation; Cutler Hammer.
 - 3. Schneider Electric; Square D.
 - 4. Siemens Industry.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure:
 - 1. NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 2. Interior Dry Locations: Type 1.
 - 3. Exterior Locations: Type 3R.
 - 4. Industrial Locations: Type 4 or 4X as indicated on drawings.
- D. Furnish switches with entirely copper current carrying parts.

2.03 SWITCH RATINGS

- A. Switch Rating:
 - 1. Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: Switches shall be listed and labeled with minimum integrated short circuit ratings based on installation.
 - 1. When installed with Class H or K fuses (30-600 ampere): 10,000 amperes rms symmetrical.
 - 2. When installed with Class R or Class J fuses (30-600 ampere): 200,000 amperes rms symmetrical.
 - 3. When installed with Class L fuses (800-1200 ampere): 200,000 amperes rms symmetrical.
 - 4. When installed without fuses: 10,000 amperes rms symmetrical.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 0529.
- B. Height: 5 feet to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 2813 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 0553.
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

- A. Section 01 4000 Quality Requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 26 2819

SECTION 26 3213

GASEOUS ENGINE GENERATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes packaged engine generators for non-emergency use with the following features:
 - LP gas engine.
 - 2. Gaseous fuel system.
 - 3. Control and monitoring.
 - 4. Generator overcurrent and fault protection.
 - 5. Generator, exciter, and voltage regulator.
 - 6. Load banks.
 - 7. Outdoor generator-set enclosure.
 - 8. Remote radiator motors.
 - 9. Vibration isolation devices.
 - 10. Finishes.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.03 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquefied petroleum.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Include thermal damage curve for generator.
 - 3. Include time-current characteristic curves for generator protective device.
 - 4. Include fuel consumption in cubic feet per hour (cubic meters per hour) at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
 - 5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
 - 6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95 deg F, 80 deg F, 70 deg F, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
 - 7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

- Include plans and elevations for engine generator and other components specified.
- 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. Identify fluid drain ports and clearance requirements for proper fluid drain.

- 4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- 5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
- 6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Source Quality-Control Reports: Including, but not limited to, the following:
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.
 - 6. Report of exhaust emissions showing compliance with applicable regulations.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to generator location.
 - c. Training plan.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Caterpillar, Inc.; Electric Power Division.
- B. Cummins Power Generation.
- C. Generac Power Systems, Inc.
- D. Kohler Power Systems.

E. Source Limitations: Obtain packaged engine generators and auxiliary components through one source from a single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 4 requirements and applicable state and local government requirements.
- E. Noise Emission: Comply with project specific criteria for maximum noise level of 73 dBA at 25 feet from enclosure in all directions due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 104 deg F.
 - Altitude: Sea level to 1000 feet.

2.03 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- 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 location and use.
- C. Power Rating: Standby.
- D. Service Load: 125 kW (156 kVA).
- E. Power Factor: 0.8, lagging.
- F. Frequency: 60 Hz
- G. Voltage: 240 V ac.
- H. Phase: Single-phase, three wire.
- I. Induction Method: Turbocharged.
- J. Governor: Adjustable isochronous, with speed sensing.
- K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- L. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
 - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- M. Engine Generator Performance for Sensitive Loads:
 - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

- a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
- 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
- 3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent stepload increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
- 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
- 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- 6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
- 7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
- 8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
- 9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
- 10. Start Time: 10 seconds.

2.04 GASEOUS ENGINE

- A. Fuel: LP gas.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control 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.
- D. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
 - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

- E. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - Minimum sound attenuation of 30 dB at 500 Hz.
 - 2. Sound level measured at 25 feet from exhaust discharge after installation is complete shall be 73 dBA or less.
- F. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- G. Starting System: 12-V electric, with negative ground.
 - 1. Components: Sized so they are not 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: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F, regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 - 6. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
 - 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 designed for lead-acid batteries. 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 F to 140 deg F 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.

2.05 GASEOUS FUEL SYSTEM

- A. Natural Gas Piping: Comply with requirements in Section 231123 "Facility Natural Gas Piping."
- B. LP Gas Piping: Comply with requirements in Section 231126 "Facility Liquefied-Petroleum Gas Piping."
- C. Gas Train: Comply with NFPA 37.
- D. Engine Fuel System:

- E. LP Gas, Vapor-Withdrawal System:
 - 1. Carburetor.
 - 2. Secondary Gas Regulator.
 - 3. Fuel-Shutoff Solenoid Valve: NRTL-listed, normally closed, safety shutoff valves.
 - 4. Fuel Filter.
 - Manual Fuel Shutoff Valve.
 - 6. Flexible Fuel Connector.
 - 7. LP gas flow adjusting valve.

2.06 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates generator-set shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- C. Comply with UL 508A.
- D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.
- E. Control and Monitoring Panel:
 - 1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
 - a. Engine lubricating-oil pressure gage.
 - b. Engine-coolant temperature gage.
 - c. DC voltmeter (alternator battery charging).
 - d. Running-time meter.
 - e. AC voltmeter, for each phase.
 - f. AC ammeter, for each phase.
 - g. AC frequency meter.
 - h. Generator-voltage adjusting control.
 - 3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
 - a. Cranking control equipment.
 - b. Run-Off-Auto switch.
 - c. Control switch not in automatic position alarm.
 - d. Overcrank alarm and shutdown.
 - e. Low water temperature alarm.
 - f. High engine temperature and shutdown.
 - g. Overspeed alarm and shutdown.
 - h. Low fuel main tank.
 - i. Coolant low-level alarm and shutdown.
 - j. Coolant high-temperature alarm and shutdown.
 - k. Coolant low-temperature alarm.
 - I. EPS supplying load indicator.
 - m. Battery low- and high-voltage alarms.
 - n. Low cranking voltage alarm.
 - o. Battery-charger malfunction alarm.

- p. Contacts for local and remote common alarm.
- q. Remote manual stop shutdown device.
- r. Hours of operation.
- s. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
- t. Generator overcurrent protective device not closed alarm.

F. Connection to Datalink:

- A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
- 2. Provide connections for datalink transmission of indications to remote data terminals via ModBus and Ethernet. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."
- G. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered at the building and shall include battery backup.
 - Overcrank alarm.
 - 2. Coolant low-temperature alarm.
 - 3. High engine temperature alarm.
 - 4. Low lube oil pressure alarm.
 - 5. Overspeed alarm.
 - 6. Low fuel main tank alarm.
 - 7. Low coolant level alarm.
 - 8. Low cranking voltage alarm.
 - 9. Contacts for local and remote common alarm.
 - 10. Audible-alarm silencing switch.
 - 11. Run-Off-Auto switch.
 - 12. Control switch not in automatic position alarm.
 - 13. Fuel tank derangement alarm.
 - 14. Fuel tank high-level shutdown of fuel supply alarm.
 - 15. Low cranking voltage alarm.
 - 16. Generator overcurrent protective device not closed.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.07 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output and system's running temperatures to predict when thermal damage of alternator will occur. When signaled by generator protector, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is

- integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
- 2. Under fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
- 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
- 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.08 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Range: Provide broad range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Dripproof.
- H. Voltage Regulator: Solid-state type, separate from exciter.
 - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 - 2. Maintain voltage within 20 percent on one step, full load.
 - 3. Provide anti-hunt provision to stabilize voltage.
 - 4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.09 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - 1. Sound Attenuated Enclosure: Yielding no more than 73 dBA at 25 feet from enclosure in all directions.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- C. Hinged Doors: With padlocking provisions.
- D. Space Heater: Thermostatically controlled and sized to prevent condensation.
- E. Lighting: Provide weather-resistant LED lighting with 50 fc average maintained.
- F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- G. Muffler Location: Within enclosure.

- H. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- I. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- J. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
- B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
- C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components, and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.
 - 3. Full load run.
 - 4. Maximum power.
 - 5. Voltage regulation.
 - 6. Transient and steady-state governing.
 - 7. Single-step load pickup.
 - 8. Safety shutdown.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation.
- C. Equipment Mounting:
 - Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Castin-Place Concrete."
 - 2. Coordinate size and location of concrete bases for packaged engine generators and Owner-furnished 1,000-gallon LP gas storage tank. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
 - 3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure enclosure to anchor bolts installed in concrete bases.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Gaseous Fuel Piping:
 - LP gas piping, valves, and specialties for gas piping are specified in Section 231126 "Facility Liquefied-Petroleum Gas Piping."
- F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel piping adjacent to packaged engine generator to allow service and maintenance.
- C. Gaseous Fuel Connections:
 - 1. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- F. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.04 IDENTIFICATION

A. Identify system components according to Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs below as specified in the NETA ATS. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.

- 3) Inspect anchorage, alignment, and grounding.
- 4) Verify the unit is clean.
- b. Electrical and Mechanical Tests
 - 1) Perform insulation-resistance tests in accordance with IEEE 43.
 - a) Machines larger than 200 hp. Test duration shall be 10 minutes. Calculate polarization index.
 - b) Machines 200 hp or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
 - 2) Test protective relay devices.
 - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
 - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
 - 5) Verify correct functioning of the governor and regulator.
- 2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - Measure charging voltage and voltages between available battery terminals for fullcharging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
- 3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- 4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- 5. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
- 6. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
- 7. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 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 terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 26 3213

SECTION 26 3553

SURGE PROTECTIVE DEVICES (SPD)

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.

1.02 REFERENCES

- A. The SPD units and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of the following:
 - 1. Listed to UL 1449 (4th Edition) and UL 1283
- B. The UL 1449 (4th edition) voltage protection rating (VPR) and label shall be permanently affixed to the SPD unit.
- C. The SPD units and all components shall be provided in accordance with the latest applicable standards of the following:
 - 1. UL 96A, 12th edition Requirements for Lightning Protection Systems.
- D. The conductors used to connect the SPD shall be installed as per NEC 285.

1.03 SUBMITTALS

- A. When requested by the Engineer the following product information shall be submitted:
 - 1. Descriptive bulletins
 - 2. Product sheets.
- B. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in section 1.04.

1.04 QUALIFICATIONS

- A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of fifteen (15) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the surge protection device equipment shall be the same manufacturer as the manufacturer of the low voltage distribution equipment in which the SPD units are installed, when integrally mounted.

1.05 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Ten (10) copies of the equipment operation and maintenance manuals shall be provided.
- B. Operation and maintenance manuals shall include the following information:
 - 1. Instruction books and/or leaflets
 - 2. Recommended renewal parts list
 - 3. Drawings and information required by section 1.06.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sentrex

- B. Eaton Corporation
- C. Current Technology SL3, TG
- D. Vertiv (Liebert) ASCO 510, 570
- E. Thor Systems TSr, TSn
- F. Schneider Electric

2.02 SURGE PROTECTION DEVICES - GENERAL

A. Electrical Requirements

- Functional Description Solid-state, 3-stage, transient voltage surge suppressor employing no series-connected suppression components. SPD shall be self-contained, separately mounted unit from the panelboard or switchboard. SPD units that are integral to the panel or switchboard will NOT be acceptable. Coordinate SPD location with panelboards, switchboards, wall equipment, etc. Provide audio alarm feature, surge counter and dry contacts on each device.
- 2. Unit Operating Voltage Refer to drawings for operating voltage and unit configuration.
- 3. Maximum Continuous Operating Voltage (MCOV) The MCOV shall be greater than 115% of the nominal system operating voltage.
- 4. The suppression system shall incorporate a hybrid designed Selenium Rectifier and/or Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and MOV based suppressor for all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
- 5. Primary Suppression Employs metal oxide varistor and/or SAD suppression module.
- 6. Secondary Suppression Employs metal oxide varistor suppression modules.
- 7. Each Suppression module circuit shall be designed to prevent damage to a suppressor during catastrophic failure of any module.
- 8. Service entrance SPD's shall have a nominal discharge rating of 20,000 amperes per UL 96A, 12th edition.
- 9. Protection Modes For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
- 10. UL 1449 4th edition Voltage Protection Ratings (VPR) The maximum UL 1449 4th edition VPR for the device must not exceed the following:

Modes	480Y/277	208Y/120
L-N; L-G; N-G	1200V	900V
L-L	2000V	1400V

B. SPD Design

- 1. Balanced Suppression Platform The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
- Electrical Noise Filter Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 30 dB at100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 30 dB @ 100 kHz shall be rejected.
- 3. Modular Devices with surge current rating less than 155kA per mode may be non-modular. Devices with surge current rating greater than 155kA per mode shall modular in design for in-field servicing.
- 4. Clamping voltage appropriate to the application shall be provided.
- 5. Internal Connections No plug-in component modules shall be used as surge current conductors.

- 6. Standard Monitoring Diagnostics Each SPD shall provide integral monitoring options:
 - a. Each unit shall provide a green / red solid state indicator light, shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.
 - b. Remote Status Monitor The SPD device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
 - c. Audible Alarm The SPD shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
 - d. Event Counter The SPD shall be equipped with an LCD display system designed to indicate to the user how many surges have occurred at the location. The events counter triggers each time after significant transient event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
- 7. Additional Monitoring Diagnostics:
 - a. Non Volatile Memory The SPD shall at least be able to save the last 1000 events.
- 8. Overcurrent Protection Fusing: In order to isolate the SPD under any fault condition, the manufacturer shall provide:
 - a. Individual Fusing: MOV's shall be individually fused. The Fuse shall allow protection during high surge (kA) events.
 - b. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.
- 9. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 1992.
- 10. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50μsec, 20kV open circuit voltage. 8 x 20μsec, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 1992 shall be:
 - a. Service Entrance & Distribution Gear: 5000 impulse per mode.
- 11. Branch Location Panelboard: 3000 impulse per mode.

2.03 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. The branch panel located TVSS shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.
- B. Surge Current Capacity -- The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table:

Minimum total surge current and withstand Capability with compliance to ANSI/IEEE C62.41			
Application	Per Mode (per phase)	Surge Withstand Capabilities ANSI/IEEE C3 Wave (10 kA)	
Service Entrance Locations (Switchboards, Switchgear, MCC, or Main Entrance)	240kA (480kA)	5000	
High Exposure or Roof Top Locations (Distribution Panelboards)	150kA (300kA)	5000	
Branch Locations (Panelboards, MCCs, Busway)	100kA (200kA)	3000	

C. Lighting and Distribution Panel Board Requirements

- The SPD application covered under this section includes lighting and distribution panel boards. The SPD units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.
- 2. The SPD shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
- 3. The SPD shall be immediately installed on the load side of the main breaker.
- 4. The panel board shall be capable of re-energizing upon removal of the SPD.
- 5. A direct bus bar connection may not be used to mount the SPD component to the panel board bus bar to reduce the impedance of the shunt path.

2.04 ENCLOSURE

- A. Construction:
 - 1. All plastics must be a minimum UL94-5V flame class rating.
 - 2. Housings shall be UL Listed and CSA Certified.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards. Upon installation, the manufacturer or manufacturer's representative shall fully test the SPD prior to energizing. Test report shall include a ground resistance test at each panel with a derived ground. Results shall be provided to the engineer and owner and recorded and returned to the panel itself.

3.02 INSTALLATION

- A. SPD's shall be installed in accordance with all appropriate Manufacturers' installation instructions and in compliance with all appropriate codes.
- B. Provide flush mounted SPD's in flush mounted panels.
- C. Provide surface mounted SPD's in surface mounted panels.
- D. Contractor may reasonably rearrange circuit breakers to achieve short, straight connection leads per NEC Article 285.12.
- E. Provide fire stop caulking at all conduit penetrations to electrical gear,
- F. SPD shall be connected via a dedicated circuit breaker. Contractor shall provide circuit breaker rated as recommended by SPD manufacturer.
- G. SPD shall be connected via low-impedance conductors furnished by the SPD manufacturer.

3.03 WARRANTY

- A. All Surge Protection Devices, associated hardware and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a minimum of ten (10) years. (Excludes installation labor and site preparations.)
- B. Warranty shall include damage due to any end-of-life electrical event, to include lightning.
- C. Any component or subassembly contained within the protector that shows evidence of failure or incorrect operation, during the warranty period, shall be replaced by the manufacturer without question. No repairs are to be acceptable, only new and unused materials are to be allowed.
- D. All surge protection devices, subassemblies and components are to be 100% tested and certified by the manufacturer to meet their published performance parameters.

END OF SECTION 26 35 53

SECTION 26 3600

TRANSFER SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes automatic and nonautomatic transfer switches rated 600 V and less.

1.03 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 transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

- Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
- 2. Include material lists for each switch specified.
- 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer-authorized service representative.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Member company of NETA.
 - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

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.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.
- E. Indicated 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.
- F. Tested Fault-Current Closing and Short-Circuit 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. Short-time withstand capability for three cycles.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- J. Neutral Switching: Provide neutral pole switched simultaneously with phase poles.
- K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "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.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front access.
- M. Enclosures: General-purpose NEMA 250, Type 1 for transfer switches located indoors and Type 3R transfer switches located outside, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.02 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. 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 unacceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.

- 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
- 4. Conductor Connectors: Suitable for use with conductor material and sizes.
- 5. Material: Hard-drawn copper, 98 percent conductivity.
- 6. Main and Neutral Lugs: Compression type.
- 7. Ground bar.
- 8. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
 - Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
 - 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
 - 3. Fully automatic break-before-make operation with center off position.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- F. Automatic Transfer-Switch Controller Features:
 - 1. Controller operates through a period of loss of control power.
 - Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phaseto-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 3. 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.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - 5. Test Switch: Simulate normal-source failure.
 - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 - 7. 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."
 - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 - 9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 - 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

- 11. 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.
- 12. 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 shall be adjustable from 10 to 30 minutes. Factory settings shall be 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 unavailable.

2.03 NONAUTOMATIC TRANSFER SWITCHES

- A. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- B. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- C. Pilot Lights: Indicate source to which load is connected.
- D. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- E. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.
 - 2. Contacts: Silver composition or silver alloy for load-current switching.
 - 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 4. Material: Hard-drawn copper, 98 percent conductivity.
 - 5. Main and Neutral Lugs: Compression.
 - 6. Ground bar.
 - 7. Connectors shall be marked for conductor size and type according to UL 1008.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. 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.
- B. Prepare test and inspection reports.
 - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.

- f. Temperature rise.
- g. Dielectric voltage-withstand; before and after short-circuit test.
- h. Overload.
- i. Contact opening.
- j. Endurance.
- k. Short circuit.
- I. Short-time current capability.
- m. Receptacle withstand capability.
- n. Insulating base and supports damage.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

3.02 CONNECTIONS

- A. Wiring Method: Install cables in raceways except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- E. Connect twisted pair cable according to Division 27 requirements.
- F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

- f. Verify that manual transfer warnings are attached and visible.
- g. Verify tightness of all control connections.
- h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
- i. Perform manual transfer operation.
- j. Verify positive mechanical interlocking between normal and alternate sources.
- k. Perform visual and mechanical inspection of surge arresters.
- I. 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.
 - Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
- 3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
- 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, perform each electrical test for transfer switches stated in NETA ATS and 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 retransfer from 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. 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.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. 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.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.
- 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. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

SECTION 26 41 13

LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. System design.
- B. Air terminals, interconnecting conductors, and other system components and accessories.
- C. Grounding and bonding for lightning protection.
- D. System inspection and certification.

1.02 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for lightning protection systems.
 - 1. Section 26 05 00 Electrical Requirements
 - 2. Section 26 05 33 Raceways and Boxes for Electrical Systems
 - 3. Section 26 05 26 Grounding and Bonding for Electrical Systems
- B. In the event of conflict involving requirements of lightning protection systems between this Section and any other Sections, the provisions of this Section shall govern.

1.03 APPLICABLE CODES AND STANDARDS

- A. The materials and installation shall conform to the minimum requirements and latest revisions of the following codes, standards and regulations wherein they apply:
 - 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

1.04 SYSTEM DESCRIPTION

A. Lightning Protection System: UL 96A Master Labeled system consisting of air terminals on roofs, roof mounted mechanical equipment, stacks, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors. Lightning protection systems shall be incorporated into the building system by the lightning protection contractor as required for a complete master labeled system.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in lightning protection equipment with minimum three years documented experience and member of the Lightning Protection Institute.
- B. Installer: The Contractor for the work covered by this specification shall be recognized as being regularly engaged in the design and installation of lightning protection systems. The Contractor must have minimum three years documented experience and member of the Lightning Protection Institute (LPI). Installer shall be a certified LPI master installer of lightning protection systems. Acceptable Installers:
 - 1. Bonded Lightning Protection Systems, LTD
 - 2. Thompson Lightning Protection, Inc.

1.06 COORDINATION

- Coordinate the work of this Section with concrete, roofing and exterior and interior finish installations.
- B. Coordinate all provisions for down conductors and system connections with all trades.
- C. Coordinate air terminal installation with roof structure, with air terminals attached to the back side of roof parapets to avoid penetration of parapet roofing.

1.07 SUBMITTALS

- A. Provide submittals for the following information in addition to and in accordance with Section 26 05 00 Electrical Requirements and Division 01 for submittal requirement.
 - 1. Shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
 - 2. Shop drawings shall include locations of conductors, roof penetrations, floor penetrations, etc., and their compatibility with provisions made during the construction. Once the contract has been established the Contractor shall make a review of provisions being made for the system installation and comment, in writing, with changes or compliance within two weeks of finalizing the contract. Contractor shall coordinate locations of conductors in walls and all penetrations with the appropriate trades: Failure to coordinate these requirements shall not relieve lightning protection Contractor from properly completing its work. This Contractor shall employ the proper trades to provide the chases in walls and roof and floor penetrations required to install the conductors if not coordinated before the floors, walls and roof are installed.
 - 3. Product data showing dimensions and materials of each component, and include indication of listing in accordance with UL 96.
 - 4. As Built Record Drawings: The Contractor shall maintain a master set of As Built Record Drawings that shows changes and any other deviations from the Base Drawings in accordance with Section 26 05 00.

1.08 MASTER LABEL

A. The system design shall equal to or exceed the requirement of UL 96A for a Master "C" Label. Upon completion, the lightning protection systems shall be inspected by a representative of Underwriters Laboratories, Inc. The lightning protection systems must pass UL inspection and wear UL label.

1.09 WARRANTY

A. Provide a warranty for material and installation per Section 26 05 00 - Electrical Requirements, unless a longer warranty period is required in specific product specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The system provided under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design.
- B. Materials used in connection of the installation of the lightning protection system shall be proved for lightning protection systems by UL. No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversized conductors shall be used.

- C. Where a mechanical hazard is involved, conductor size shall be increased to compensate therefore, or suitable protection shall be provided. The conductors may be protected by covering them with molding or tubing made of nonmetallic material.
- D. Aluminum materials may not be used except on roofs that utilize aluminum roofing components. When aluminum materials are used, provide all materials of aluminum composition to ensure compatibility, except down conductors and grounding. Provide copper down conductors with bimetal transition at the roof assembly rated for the application.

2.02 CONDUCTORS

A. All conductors shall be stranded copper and of the grade ordinarily required for commercial electrical work generally designated as being 98 percent conductive when annealed. Aluminum conductors may only be used on roofs that are built of aluminum roofing components. Conductor minimum size shall be in compliance with NFPA 780.

2.03 AIR TERMINALS

A. Air terminals shall be copper or copper alloy per UL 96. A copper or copper alloy air terminal intended for use on a chimney shall have a hot-dipped lead coating or equivalent. Class II air terminal shall be of solid construction. Air terminal minimum diameter shall be in compliance with NFPA 780.

2.04 GROUND ROD

A. Ground rod shall be copper-clad steel, ¾-inch diameter by 10 feet in length.

2.05 CONNECTIONS

- A. Connector fittings shall be corer or copper alloy per UL 96 and compatible with material type used for air terminals and conductors.
- B. Conductor splices and connectors shall be compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.
- All below ground and concealed connections shall be made with exothermic welded connections.

2.06 ROOF PENETRATIONS

A. Roof penetrations shall be accomplished with through-roof fittings specially designed for this purpose. Through-roof fittings shall utilize solid rods with appropriate hardware. Fittings shall incorporate a positive means for sealing around the rod.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify that field measurements are as shown on the shop drawings.
- C. Beginning of installation means installer accepts existing conditions.

3.02 PROTECTION OF SURROUNDING ELEMENTS

A. Protect elements surrounding work of this Section from damage or disfiguration.

3.03 CONDUCTORS

A. Install in accordance with manufacturer's instructions. Conceal down conductors.

Concealed down conductors shall be installed in continuous insulating PVC raceways.

Metallic raceways shall not be used.

- B. PVC conduit shall not be installed in plenums. If PVC conduit has to be installed in plenum space, the PVC conduit shall have fire rated walls installed creating a chase space for the conduit.
- C. The Contractor shall bond each down conductor to the ground rod (Cad-Weld or equivalent) which is bonded to the counterpoise conductors creating a common ground.
- D. No bend of a conductor shall form an angle beyond 90 degrees nor shall have a bend radius less than 8 inches per NFPA 780.

3.04 AIR TERMINALS

- A. Air terminal height and support shall be in compliance with the requirement of NFPA 780.
- B. Air terminals shall not be mounted such they have to be moved to perform maintenance on the equipment they protect.

3.05 GROUND RING ELECTRODE

- A. A ground ring electrode encircling the building or structure shall be installed. Lightning protection systems down conductors shall be connected to the ground ring electrode.
- B. Interconnect lightning protection ground ring electrode with building ground electrode system.

3.06 ROOF CONNECTIONS

- A. Make direct connections to lightning protection system with copper conductor for all roof mounted equipment, enclosures, mast, fan stacks and all metallic objects alike. Provide bonding jumpers across all equipment mounting isolators and ductwork isolators to provide a complete ground path.
- B. All antennas shall be grounded.

3.07 ROOF ATTACHMENT AND PENETRATIONS

- A. Roof penetration. Contractor shall inform Owner's representative, in advance, of any required roof penetrations and shall obtain approval. Wherever the system penetrates the roof, approved through-roof fittings or sleeves shall be furnished by the lightning protection contractor and installed by the roofing contractor. All patching masonry and structural work shall be furnished and installed by the general contractor.
- B. All attachments to roofs must be in strict accordance with the roof manufacturer's recommendations. The lightning protection contractor shall submit details of all roof attachment to the appropriate roof manufacturer for approval prior to installation. Once the lightning protection system installation is complete, the lightning protection contractor shall engage the appropriate roof manufacturer to inspect all roof attachments on that manufacturer's roof. Subsequent to the inspection, the roof manufacturer shall furnish the Owner with a letter indicating that all lightning protection systems component roof attachment and penetration are satisfactory and such attachments and penetrations will not in any way to void or reduce the warranty on roof. Any fees for services or inspections provided by the roof manufacturer to accomplish the above related requirements shall be at the expense of the lightning protection contractor.

3.08 COVER-UP INSPECTION

A. Prior to cover-up of concealed components and connections, notify the Owner so that a cover-up inspection can be performed. Correct any deficiencies prior to concealment of components and connections.

3.09 INSPECTION AND MASTER LABEL

- A. Upon completion, the lightning protection systems shall be inspected by the representative of the Owner.
- B. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection systems. If the system does not pass UL inspection, the Contractor must make corrections to the system in order to pass inspection. Contractor shall furnish the Owner with appropriate approval certificate.
- C. Obtain UL Master Label and attach to building at a location as directed by Owner.

3.10 CONFLICTS

A. In the event a conflict exists between this specification and any of the referenced standards, the requirements of referenced standards govern. Necessary variances or corrections shall be made at the expense of the lightning protection contractor in order to obtain UL Master Label.

END OF SECTION 26 41 13

SECTION 26 5100 INTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.
- B. Related Sections:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections apply to this Section.
 - 2. Section 23 3700 Air Outlets and Inlets: For interface with air handling fixtures.
 - 3. Section 26 0526 Grounding and Bonding for Electrical Systems.
 - 4. Section 26 0533 Raceway and Boxes for Electrical Systems.
 - 5. Section 26 5200 Emergency Lighting.
 - 6. Section 26 0923 Lighting Control Devices

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C78.377 Chromaticity for White Light LED
 - 2. ANSI C82.1 American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 3. ANSI C82.4 American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 4. ANSI C82.16 Light-Emitting Diode Drivers.
- B. All lighting control systems, components and devices shall be wired in lieu of wireless. Use of wireless networks, components and/or devices shall only be used when expressly approved by the Engineer and only in those locations designated by the Engineer.

1.03 SUBMITTALS

- A. Shop Drawings:
 - Indicate dimensions and components for each luminaire not standard product of manufacturer.
- B. Photometric Drawings:
 - 1. Electrical contractor shall submit lighting foot-candle photometric floor and site plans in AutoCAD format as part of the required lighting submittal.
- C. Wiring Diagrams:
 - 1. Provide complete wiring diagrams for all lighting control components and systems.
- D. Product Data:
 - 1. Submit dimensions, ratings, and performance data.
 - 2. Submit catalog cut sheets identified by fixture type for all lighting fixtures.
- E. Samples
 - 1. Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where so indicated in the Lighting Fixture Schedule.

1.04 QUALIFICATIONS

- A. Manufacturer:
 - 1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Alternate Manufacturer:

- 1. Fixtures on the Lighting Fixture Schedule on the electrical drawings are specified as the basis of design. Contractor may submit alternate equal fixtures, matching the appearance and electrical and lighting characteristics of those fixtures specified.
- 2. Contractor shall submit complete photometric submittal in AutoCAD format for all cases where Contractor proposes alternate fixtures from those specified.
- 3. Lighting fixtures that do need meet the requirements of those scheduled in the Lighting Fixture Schedule, the photometric requirements and the lighting control requirements will be rejected.

1.05 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.06 MAINTENANCE MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each plastic lens type.
- C. Furnish two of each ballast type.
- D. Furnish 5% of each type of lamp.

PART 2 PRODUCTS

2.01 INTERIOR LUMINAIRES

- A. Product Description:
 - Complete interior luminaire assemblies, with features, options, and accessories as scheduled on the electrical drawings.
- B. Refer to Section 01 60 00 Product Requirements for product options.

2.02 LED FIXTURES

- A. LED fixtures shall meet the following requirements:
 - 1. 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - 3. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 - 4. Recessed Fixtures: Comply with NEMA LE 4.
 - 5. Bulb shape complying with ANSI C79.1.
 - 6. Lamp base complying with ANSI C81.61 or IEC 60061-1.
 - 7. CRI of minimum 80. CCT of 4100 K.
 - 8. Rated lamp life of 50,000 hours.
 - 9. Lamps dimmable from 100 percent to 0 percent of maximum light output.
 - 10. Internal driver.
 - 11. Nominal Operating Voltage: as indicated on schedule.
 - 12. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - 13. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Powder coat finish

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires independent of ceiling framing.
- C. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- D. Exposed Grid Ceilings:
 - 1. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips. Provide additional support wire equal to support wire from fixture to structure at each corner. These wires are separate and independent of ceiling supports.
- E. Install recessed luminaires to permit removal from below.
- F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Install clips to secure recessed grid-supported luminaires in place.
- H. Install wall-mounted luminaires at height as indicated on Drawings.
- I. Install accessories furnished with each luminaire.
- Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.
- K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- L. Install specified lamps in each luminaire.
- M. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as indicated on Drawings.

3.04 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.05 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting finished work.
- B. Re-lamp luminaires having failed lamps at Substantial Completion.

END OF SECTION 26 51 00

SECTION 27 10 00

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

- 1.01 This section identifies the requirements, technical design, and specifications for the structured cabling system at the State Park, located in Tyler, Texas ("Owner"). The structured cabling system as specified is an Industry-Standard Category 6 structured cabling system horizontal cabling and termination hardware as specified.
- 1.02 The Contractor shall provide a Manufacturer's 20-Year Performance Certification for the installed structured cabling system.
- 1.03 Contractor shall include materials, equipment, and labor necessary to provide a complete and functional structured cabling system regardless of any items not listed or described in this specification or associated drawings.
- 1.04 Requirements
 - 1.05 Related Requirements
 - 1.06 Submittal Requirements
 - 1.07 General Requirements
 - 1.08 Acceptable Manufacturers
 - 1.09 Codes, Standards and Regulations
 - 1.10 General Requirements
 - 1.11 System Requirements
 - 1.12 Testing Requirements
 - 1.13 Project Closeout Documentation
 - A. Attachments
- 1.05 Related Requirements
 - A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 27, and shall be complied with in every respect. The Contractor shall examine all of the items which make up the Contract Documents and shall coordinate them with the work on the project.
 - B. Contractor Experience Requirements
 - 1. The Contractor shall be **Panduit Certified** prior to submitting a bid for the work.
 - 2. The Contractor shall possess all relevant Manufacturer Certifications (i.e. structured cable systems, testing equipment, etc.,) for both the company and individual technicians prior to submitting a bid for the work.

- 3. The Contractor's Project Manager shall be a Registered Communications Distribution Designer (RCDD) and available for all onsite coordination meetings.
- 4. The Contractor shall have been in business for a minimum of five (5) years.
- 5. The Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of the project site.
- 6. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- C. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.06 Submittal Requirements

- A. Pre-Installation Submittal
 - Contractor shall not order, purchase, or install any equipment until preinstallation submittals have been accepted in writing by the Architect/Engineer.
 - Contractor shall ensure submittals are submitted in a timely manner to ensure all
 products can be ordered and received on site in order to not cause any delays.
 If there are any concerns with any products having long lead times, those
 products shall be clearly identified in writing so the review and approval can be
 expedited.
 - 3. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e. product data in the sequence items are listed in the product data section, manufacturer product certifications for company, manufacturer product certifications for installers, etc.). Submittals not in the proper sequence will not be approved.
 - 4. Manufacturer product data sheets for each proposed system component.
 - a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
 - 5. Manufacturer Product Certifications for Company.
 - 6. Manufacturer Product Certifications for Installers.
 - 7. Manufacturer Certifications for testing equipment technicians.
 - 8. Manufacturer Certifications for testing equipment calibration.
 - 9. RCDD Certificate for Contractor's Project Manager.
 - 10. Manufacturer Warranty letter.
 - 11. Documentation indicating that Contractor has been in business for (5) years.

- 12. Address of Contractor's local office within a 75-mile radius of the project site.
- 13. Quantity of full time local technicians within a 75-mile radius of the project site.
- 14. List of five (5) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- 15. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- 16. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any work on the project, submit a statement on company letterhead clearly indicating no subcontractors will be performing any work on this project.

PART 2 - PRODUCTS

- 1.07 General Requirements
 - A. The following sections specifically list the acceptable equipment types and items for this project.
 - B. Architect/Engineer will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
 - C. Proposed equivalent items must be approved in writing by the Architect/Engineer prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
 - D. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall substitute the appropriate equivalent manufacturer's part number.
 - E. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished.
 - F. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
 - G. All wiring, equipment, and installation materials shall be new and of the highest quality.
 - H. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
 - I. Original Equipment Manufacturer (OEM) documentation must be provided to the Architect/Engineer which certifies performance characteristics and compliance with ANSI/TIA 568-D standards.

- J. Contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. Contractor shall clearly identify any concerns with lead times in writing to the Architect/Engineer prior to submitting a proposal for this work. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues and the Contractor will have all products on-site when needed to complete the job as required.
- 1.08 Acceptable Manufacturers
 - A. Horizontal Cable
 - 1. Category 6 UTP Plenum
 - a. Network Access (Blue Sheath)
 - 1. Panduit Cat 6 Part Number PUP6004BU
 - b. Wireless Access Points (Blue Sheath)
 - Panduit Cat 6 Part Number PUP6004BU
 - c. IP Security (yellow)
 - 1. Panduit Cat 6 Part Number PUP6004YL
 - 2. Category 6 Horizontal Rack Mounted Patch Panels
 - a. 48 Port Patch Panels Part No. DP48688TGY
 - b. 24 Port Patch Panels Part No. DP24688TGY
 - 3. Category 6 Jacks
 - a. Network Access
 - 1. Field End (Blue)
 - a) Panduit Mini-Com UTP Jack Modules Part No. CJ688TGBU
 - b. Wireless Access Points
 - 1. Field End (Blue)
 - a) Panduit Mini-Com UTP Jack Modules Part No. CJ688TGBU
 - c. IP Security
 - 1. Field End (Yellow)
 - a) Panduit Mini-Com UTP Jack Modules Part No. CJ688TGYL
 - 4. Telecommunications Faceplates with Designation Window
 - a. 2-Port Single Gang Flush
 - 1. Panduit Mini-Com Faceplates with Labels Part No. CFPL2IWY

- 2. Panduit Mini-Com Executive Series Faceplates with Labels Part No. CFPE6xxY (xx-denotes color) (White)
- b. 4-Port Single Gang Flush
 - 1. Panduit Mini-Com Faceplates with Labels Part No. CFPL4IWY
 - 2. Panduit Mini-Com Executive Series Faceplates with Labels Part No. CFPE4IWY (XX-denotes color) (White)
- 5. 2-Port Surface Mount Box (White)
 - a. Panduit Mini-Com Surface Mount Box Part No. CBXJ2WH-A
- 6. Blank Insert (White)
 - Panduit Mini-Com Blank Module Part No. CMBWH-X
- B. Labeling
 - 1. Permanent Labels for Copper Cables
 - a. Laser/Ink Jet Self Laminating Labels
 - 1. Panduit Part Number Series S100X******
 - 2. Permanent Labels for Patch Panels
 - a. Panduit Component Label
 - 3. Permanent Labels for Faceplates
 - a. Panduit Component Label
- C. Fire Stop
 - 1. 2 or 4 inch EZ Path Sleeves (Match Existing Conditions)
- D. Copper Patch Cables
 - Panduit Category 6 UTP Patch Cord Part Number UTP6AXXZZ denotes color other than off white, zz denotes length
 - 2. MDF/IDF End Panduit 28 AWG Category 6 modular non-booted patch cable Part Number UTP28XXZZ
 - *xx denotes length zz denotes color other than off white
 - 3. Contractor shall coordinate with the owner prior to purchasing patch cords to verify quantity, colors and lengths.
- E. Floor Box Device
 - 1. FSR Audio Visual Floor Box Part Number FSR 500P-4-3 (Provided by Div 27, installed by Div 26)

- 2. Floor Box Inserts for Audio Visual Connections Contractor shall use Legran Floor Bos Inserts if required or can use the standard faceplate listed above (by contractor)
- 3. Panduit 106 Inserts for Data Jacks, Panduit Part # CF1064WHY (white)
- F. Equipment Racks, Cabinets, Cable Management, and Accessories
 - 3. Equipment Rack (Black) with Vertical Wire Managers.
 - Panduit Floor Mounted 19" x 84" standalone floor mounted rack. Part No. CMR19X84
 - b. Panduit Vertical Wire Managers. Part Number CMVDR2S.
 - 4. Horizontal Wire Managers (Black)
 - a. Horizontal Cable Mangers Panduit Part No. CMPHHF1
 - 5. Horizontal Power Strips (Black)
 - a. Chatsworth Power Strip with Nema 5-15P Plug and (10) 5-15R receptacles -Part No. CMRPSH15
 - 6. Cubit Filter Fan Kit Assembly
 - a. Chatsworth Fan Kit 115 VAC 100 CFM Part No. 12804-701
- G. Cable Runway (Ladder Type)
 - 7. Universal Cable Runway
 - a. 12-inch Chatsworth Part Number 10250-712
 - 8. Cable Runway Radius Drop, Cross Member
 - a. 12-inch Chatsworth Part Number 12100-712
 - 9. Cable Runway Radius Drop, Stringer
 - a. Chatsworth Part Number 12101-701
 - 10. Cable Runway Butt-Splice Kit
 - a. Chatsworth Part Number 11301-701
 - 11. Cable Runway Junction-Splice Kit
 - a. Chatsworth Part Number 11302-701
 - 12. Cable Runway Butt-Swivel Splice Kit
 - a. Chatsworth Part Number 10487-701
 - 13. Cable Runway Elevation Kit for Cabinets

- a. Chatsworth Part Number 10506-716
- 14. Triangular Support Bracket, Aluminum
 - a. 6 to 12-inch runway Chatsworth Part Number 11312-712
 - b. 12 to 18-inch runway Chatsworth Part Number 11421-718
- 15. Wall Angle Support Kit, Cable Runway
 - a. 12-inch runway Chatsworth Part Number 11421-712
- 16. 90 Degree Runway-Splice Kit
 - a. Chatsworth Part Number 11314-701
- 17. 45 Degree Runway-Splice Kit
 - a. Chatsworth Part Number 11313-701
- 18. Foot Kit, Cable Runway
 - a. Chatsworth Part Number 11309-001
- 19. Vertical Wall Brackets (pair)
 - a. Chatsworth Part Number 10608-701
- 20. Threaded Ceiling Kit, Cable Runway
 - a. Chatsworth Part Number 11310-001
- 21. Threaded Rod Cover
 - a. Chatsworth Part Number 11085-001
- 22. Protective End Caps for Cable Runway
 - a. Chatsworth Part Number 10642-001
- 23. End Closing Kit, Cable Runway
 - a. Chatsworth Part Number 11700-712
- H. Pathway Cable Support
 - 24. Panduit J-Pro Cable Support System
 - 25. Erico CADDY CAT LINKS J-Hook Series
 - 26. Erico Caddy Adjustable Cable Support Series
 - 27. Panduit Plenum Rated Hook & Loop (Black)
 - 28. Erico Caddy Grid Support Part Number ATA41 or ATS41
- I. Grounding and Bonding

- 29. Grounding Bus Bar, 20"
 - a. Chatsworth Part Number 40153-020
- 30. Grounding Bus Bar, 12"
 - a. Chatsworth Part Number 13622-012
- 31. Cable Runway Ground Strap Kit
 - a. Chatsworth Part Number 40164-001
- 32. One Mounting Hole Ground Terminal Block
 - a. Chatsworth Part Number 08009-001
- 33. Horizontal Rack Ground Bar for Wall Mount Cabinet
 - a. Chatsworth Part Number 10610-019
- 34. #6 AWG Solid Green Insulation Ground Wire
 - a. Superior Essex Part Number 12-018-04
- 35. #3/0 Stranded Green Insulation Ground Wire
- 36. Cable Sheath Bonding Clamp
- J. Power Strips
 - 37. Panduit Horizontal Power Strip with 20 amp circuit, 10 recepticles, 10 ft power cord with nema 5-20 plug. Part Number CMRPSH20.
- K. HDMI Inputs
 - 38. Crestron Display Receiver- Crestron HD-RX101-C-E
 - 39. Crestron Wall Mounted Transmitter: Crestron HD-RX-101-C-1G-E
 - 40. 15-FT HDMI Cable Show me Cables 41-140-08M

PART 3 - EXECUTION

- 1.09 Codes, Standards, Regulations
 - A. American National Standards Institute (ANSI)
 - B. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

- 3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
- 4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials
- C. Alliance for Telecommunications Industry Solutions (ATIS)
- D. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 13th Edition
 - 2. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - 3. NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling
 - 4. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- E. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits, revised 1998
 - FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
 - 3. FCC Part 76, Cable Television Service, revised 1998
- F. Insulated Cable Engineers Association (ICEA)
 - 1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
 - ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
- G. International Electrotechnical Commission (IEC)
- H. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - 1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System
 - 2. IEEE Standard 1100-1999, Recommended for practice for Powering and Grounding Sensitive
 - 3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
 - 4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
 - 5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
- I. International Organization for Standardization (ISO)

- International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
- 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
- 3. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- 4. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
- 5. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- J. National Cable Television Association (NCTA)
- K. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits
- L. National Fire Protection Association (NFPA)
 - 1. NFPA-70, National Electrical Code
 - 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 - 3. NFPA-101, Life Safety Code
 - 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 - 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- M. National Institute Standards and Technology (NIST)
- N. Occupational Safety and Health Administration (OSHA)
- O. Telecommunications Industry Association (TIA)
 - 1. ANSI/TIA-568-D, Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568-D, Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA -568-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
 - 4. ANSI/TIA-568-D Optical Fiber Cabling Components Standard.
 - 5. ANSI/TIA–569-E, Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA-606-C, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 - ANSI/TIA-607-D, Commercial Building Grounding and Bonding Requirements for Telecommunications

- 8. ANSI/TIA-758-C, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
- P. U.S. Department of Agriculture (USDA)
 - RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
 - 2. RUS Bull 1751F-643 Underground Plant Design
 - 3. RUS Bull 1751F-815 Electrical Protection of Outside Plant
 - 4. RUS Bull 1753F-201 Acceptance Tests of Telecommunications Plant (PC-4)
 - 5. RUS Bull 1753F-401 Splicing Copper and Fiber Optic Cables (PC-2)
 - 6. RUS Bull 345-65 Shield Bonding Connectors (PE-65)
 - 7. RUS Bull 345-72 Filled Splice Closures (PE-74)
 - 8. RUS Bull 345-83 Gas Tube Surge Arrestors (PE-80)
- Q. Underwriters Laboratories, Inc. (UL)
 - 1. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
 - 2. UL 910 Applicable Flame Test
 - 3. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify the Architect/Engineer in writing of any such occurrences before purchasing or installing any equipment or materials. The Architect/Engineer will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.

1.10 General Requirements

- Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the Architect/Engineer for direction before proceeding with that part of the work.
- 2. The Contractor shall be responsible for coordination with other trades to ensure any conflicts or potential conflicts are resolved prior to any work beginning on the project.
- 3. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines.
- 4. No deviations from the plans or specifications shall be made without full consent in writing of the Architect/Engineer. The Contractor shall have written approval from the Architect/Engineer for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain

- written approval from the Architect/Engineer prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- The Contractor shall obtain written permission from the Architect/Engineer before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.
- 6. Contractor shall notify the Architect/Engineer a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect/Engineer to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- 7. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- 8. Equipment and materials installed by the Contractor shall be free of defects and damage.
- 9. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.
- 10. Contractor shall test all cables prior to installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.
- 11. Contractor shall maintain a set of working specifications, design drawings, and record drawings to be kept on site at all times and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect/Engineer.
- 12. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- 13. Equipment and materials shall be delivered and stored in accordance with the manufacturer's quidelines at the Contractor's expense.
- 14. Contractor shall make all stored equipment and materials available for inspection at the request of the Architect/Engineer.
- 15. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.
- 16. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.
- 17. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
- 18. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- 19. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.

1.11 System Requirements

 Quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a complete and functioning system. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity shall be furnished.

2. Horizontal Cable

- a. No horizontal cable shall be longer than two hundred ninety-five (295) feet. If any station cable will be longer than two hundred ninety-five (295) feet, Contractor shall stop installation of the cable and immediately notify Architect/Engineer in writing. If Contractor fails to notify the Architect/Engineer in writing, Contractor shall replace cable at no cost to the Owner.
- b. The Contractor shall furnish and install horizontal cables within each Technology Region from the respective ER or TR to each outlet location as indicated in the technology drawings.
- c. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored above the ladder rack in each respective Equipment Room or Telecommunications Room.
- d. The Contractor shall provide a 2-foot service loop coiled and supported directly above the workstation outlet.

A. Horizontal Cable Termination

1. Contractor shall terminate cables as defined by the ANSI/TIA 568.-D Commercial Building Wiring Standard with the EIA-568B sequence.

2. Workstations

- a. Contractor shall furnish and install modular jacks to terminate UTP horizontal cables.
- b. Contractor shall furnish and install faceplates, systems furniture faceplates, or surface-mount boxes to house modular jacks as indicated in the technology drawings.
- c. Any unused faceplate positions shall have an appropriate number and color of blanks installed.

3. Equipment Rooms / Telecommunications Rooms

- a. Horizontal Cable for Data
- 1. Contractor shall furnish and install patch panels and horizontal cable managers to terminate horizontal data cables as indicated in the technology drawings.

Contractor shall terminate all wireless access point cables in a row together on the same patch panel. Wireless access cables shall **NOT** be terminated sporadically. Wireless cable shall also be labeled "WAP" at the patch panel port

b. Horizontal Cable for IP Security

 Contractor shall furnish and install patch panels and horizontal cable managers to terminate horizontal IP security cables as indicated in the technology drawings.

Contractor shall confirm with the owner the location of new patch panels prior to termination of new horizontal cables.

A. Patch Cables

1. Copper

Workstations

- 1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated.
 - a) 100% of the patch cables shall be (10) feet in length and stored in the applicable Equipment Room / Telecommunications Room.

b. Equipment Rooms / Telecommunications Rooms

- 1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated per Equipment Room / Telecommunications Room:
 - a) 50% of the patch cables shall be (5) foot in length and stored in the applicable Equipment Room / Telecommunications Room
 - b) 25% of the patch cables shall be (7) foot in length and stored in the applicable Equipment Room / Telecommunications Room
 - c) 25% of the patch cables shall be (10) foot in length and stored in the applicable Equipment Room / Telecommunications Room
 - d) Contractor shall coordinate with the owner on quantities, colors and lengths prior to purchase.

B. Cable Support

- 1. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
- When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Contractor furnished and installed j-hooks or adjustable cable supports.
- 3. No cable pathway shall exceed 40% fill ratio.
- 4. The contractor shall furnish a separate j-hook or adjustable cable support pathway for each cable type (data, voice, video, and security).
- J-hooks and adjustable cable supports shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.

- 6. J-hooks and adjustable cable supports shall be installed no higher than 3-feet above the accessible ceiling to allow for ease of access for future moves, adds and changes
- 7. If utilizing ceiling grid wire, that is contractor installed, both ends shall be supported and independent from the grid wire to provide support for the actual grid and ceiling tile. Grid wire shall be painted blue and attached to ceiling grid with a Caddy Component Support.
- 8. J-hooks shall be furnished with closure clips.
- 9. Maximum sag between supports shall not exceed twelve-inches (12").
- 10. Contractor shall establish j-hook and adjustable cable supports pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.

11. Cable Dressing

 No nylon cable ties shall be used at any time during the installation of the cable.

b. Above Ceiling

- 1) Contractor shall furnish and install plenum-rated hook & loop straps in plenum-rated airspaces.
 - a) The Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
- c. Equipment Rooms / Telecommunications Rooms
 - 1) The Contractor shall bundle all visible cables with Contractor furnished and installed hook & loop straps.
 - a) Hook & loop straps shall be installed twenty-four (24) inches apart on center.

C. System Labeling

- 1. Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.
- 2. Horizontal Cables shall be labeled within (12) inches from the termination point inside the Equipment Room/Telecommunications Rooms.
- 3. Horizontal Cables shall be labeled within (6) inches from the termination point at the workstation end.
- 4. Horizontal Cable
 - a. Inside Equipment Rooms

- 1) Horizontal cables shall be labeled at each end with the destination end and origin room number, patch panel number, and port number. (i.e. 007-IT03-A01).
- 2) Each Port of structured cable copper patch panels shall be individually labeled with the destination wall jack port.
- 3) Patch panels in each closet shall be labeled sequentially starting with the first Patch Panel in the top of the first relay rack (A, B, C, D, E, etc.).
- 4) All patch panels will indicate the room number along with the patch panel port designation. The labels shall be mechanical labels that are neatly printed with uniform font and evenly spaced across the patch panel. Room numbers will be in sequential order throughout the panels as indicated on the drawings.
- 5) All Labels shall be adhesive P-Touch type labels (White Backing with Black Letters).

5. Workstation Faceplates

 Cables and wall plates shall be labeled denoting origin, Equipment Room/Telecommunications Room Number, Patch Panel, Port Number. (i.e. 007-A01).

1.12 Testing Requirements

A. Category 6 UTP Cable

- 1. Cable links shall be tested in accordance with industry standards.
- 2. Only Manufacturer Certified Technicians shall perform testing.
- 3. The Contractor shall test and certify the structured cable system with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
- 4. No Fail or *Pass results will be accepted.
- The Contractor shall notify the Architect/Engineer a minimum of five (5) days in advance to observe field testing.
- 6. The Architect/Engineer may randomly select 5% of the installed links for test verification purposes. The Contractor shall re-test these links in the presence of the Architect/Engineer and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed links at no cost to the Owner.

1.13 Project Closeout Documentation

A. As-Built Drawings

- 1. Drawings shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect/Engineer.
- 2. Three (3) sets of drawings depicting the condition of the structured cabling system as installed.
- As-Built drawings shall be produced in AutoCAD 2017 or higher and provided in hardcopy and electronically in .dwg and PDF format.
- 4. Hardcopy drawings shall be provided in the original size as issued by the Architect/Engineer.
- 5. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect/Engineer.
- 6. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, backbone and horizontal cable pathways, workstation locations, and labeling scheme.

B. Test Documentation

- 1. Test documentation shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until these test results are received and approved by the Architect/Engineer.
- 2. Three (3) sets of test documentation for the structured cabling system as installed.
- Test results shall be provided in hard copy and electronic format (i.e., manufacturer's proprietary testing software along with applicable reader software) and PDF electronic format.
- 4. Test documentation shall be bound, sectioned, and tabbed in the following sequence as applicable:
 - Tester(s) Calibration Certificate(s)
 - b. Horizontal Category 6 Cable

C. Manufacturer's Performance Certification

- Certificate shall be provided to the Architect/Engineer at the time of final system acceptance. Final payment will not be recommended until the certificate of certification is received and approved by the Architect/Engineer.
 - a. The manufacturer of the solution shall furnish a performance certification as per the specifications starting at final system acceptance.
 - b. One original and two copies of the Manufacturer's Certificate shall be provided.
- D. Manufacturer's Product Warranty

- Certificate of product warranty shall be provided to the Architect/Engineer at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect/Engineer.
 - a. The manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
 - b. One original and two copies of the Manufacturer's product warranty shall be provided.

E. Contactor's Statement of Warranty

- 1. Statement of warranty shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Engineer.
 - a. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
 - One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e. Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION 27 10 00

SECTION 28 1300

ACCESS CONTROL SYSTEM

PART 1 - GENERAL

- This section of the access control specification identifies the requirements and technical design for the Access Control System for Texas Department of Parks and Wildlife-Tyler State Park located in Tyler, Texas ("Owner"). The access control system as specified shall be a commercially available, industry-standard product and shall be Mercury controller-based. The access control system shall include all devices, materials and labor to provide a complete and functional access control system. The access control system includes, access control software and hardware, Mercury controllers and sub controllers as required, electronic locking hardware power supplies, request to exit devices, door position sensors, card readers, cabling and pathways/conduit systems, access control cards and an access control server(s). This system shall be provided to the owner as a fully functional access control system, with no exceptions
- In the execution of this work, the Security Contractor shall comply with the requirements of local laws and ordinances, the laws of the State of Texas, the National Board of Fire Underwriters, OSHA, accepted industry standards and the National Electrical Code. If, in the opinion of the Security Contractor, there is anything in the specifications that will not strictly comply with the above laws, ordinances, and codes, the matter shall be referred to the Security Consultant for a decision before proceeding with that part of the work.
- 1.3 The Security Contractor shall include materials, equipment, and labor necessary to provide a complete (Turn-key) and functional access control system regardless of any items not listed or described in this specification or associated drawings.
- 1.4 The Security Contractor and employees shall be factory trained and hold a certification for the access control systems proposed to be installed for this project. The Security Contractor shall be and authorized distribution and integration partner of the proposed system(s) prior to submitting a proposal for this work.
- 1.5 The Security Contractor shall submit a clear and legible copy of the company's certificates and applicable licensing of the proposal response as part of their proposal. Failure to include this information may result in DISQUALIFICATION of the Security Contractors response documents.
- 1.6 Requirements
 - 1. Security Contractor Experience Requirements
 - 2. Submittal Requirements
 - 3. Acceptable Manufacturers
 - 4. Codes, Standards and Regulations
 - 5. General Requirements
 - 6. System Requirements
 - 7. Testing Requirements
 - 8. Training Requirements
 - 9. Project Closeout Documentation
 - 10. Attachments
- 1.7 Related Requirements
 - 1. The Drawings, Specifications, General Conditions, Technical Appendix, Supplementary General Conditions, and other requirements of the Owners bid documents apply to the work specified herein Division 28 Access control system and shall be complied with in every respect. The Security Contractor shall examine all the items which make up the Contract Documents and shall coordinate the requirement to the proposed scope of work for this project.

- 2. Security Contractor Experience Requirements
 - a) The Security Contractor shall possess all relevant Manufacturer Certifications (i.e. hardware installation, software installation and programming, etc.) for both the company and individual technicians prior to submitting a bid for the work. The Security Contractor shall provide proof of this requirement as part of their proposal.
 - b) The Security Contractor shall have been in the electronic security business for a minimum of five (5) years and provide proof of this requirement as part of their proposal.
 - c) The Security Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of the location of the installation.
 - d) The Security Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
 - e) The Security Contractor will provide as part of their proposal the following additional items:
 - A detailed Safety Plan for the project.
 - 2) A detailed construction schedule (Gantt Chart) for the project.
 - 3) A detailed description of the installation team(s) that would perform the work.
 - 4) A resume for each of the key project personal.
 - 5) 2nd, 3rd, 4th and 5th YEAR extended warranty services/SSA and cost.
 - 6) Lifetime SSA (one-time) software licensing cost.
 - 7) Any Software Support Agreement costs for years 2 through 5 after the installation.
- 3. All Sub Contractors and their scope of work shall be identified at the time of bid. All Sub Contractors will fully comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.8 Submittal Requirements

- 1. Pre-Installation Submittal
 - a) The Security Contractor shall not order, purchase, or install any equipment/software until pre-installation submittals have been accepted in writing by the Security Consultant and Owner. The Security Contractor shall submit a complete pre-installation submittal package as described herein to the Security Consultant for review within 20 business days of award of contract. The Pre-installation submittals shall include at a minimum the following items:
 - b) Manufacturer product data sheets for each proposed system component.
 - 1) The Security Contractor shall provide product data sheets, products containing more than one (1) part number or product, the Security Contractor shall clearly identify the specific part number or product being submitted. Equipment schedules listing all system components, the manufacturer, model number and quantity of each shall also be included in the submittal package.
 - c) Shop drawings of the proposed system installation.
 - As part of the Pre-Installation Submittal the Security Contractor shall provide Shop drawings that will include card reader locations, door position sensor locations, access control panel elevations to include layout of all devices, power supply locations, complete installation details, preliminary cabling numbering strategy, proposed cable pathways, complete system schematics, and riser diagrams. The Shop drawings shall be submitted on 30" X 42" bond paper.
 - 2) The Security Contractor shall always maintain a set of shop drawings on site and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Security Consultant.
 - 3) As part of the Pre-Installation Submittal, the Security Contractor will provide a Gantt Chart construction schedule. The Security Contractor will maintain an accurate construction schedule throughout the project

and share the construction schedule with the owner's project management team during a weekly project status meeting.

- a) The construction schedule shall at a minimum include:
 - 1. Critical path
 - 2. Longest path
 - 3. Milestones
 - 4. Activity Float and Schedules
 - 5. Critical path for fabrication of devices/systems
 - 6. The Responsibilities of the Parties
- d) Manufacturer Product Certifications for Company.
- e) Manufacturer Product Certifications for Installers.
- f) Manufacturer Warranty letter.
- g) Documentation indicating that Security Contractor has been in business for (5) years.
- h) Address of Security Contractor's local office within a 75-mile radius of the project site.
- i) Quantity of full-time local technicians within a 75-mile radius of the project site.
- j) List of five (5) Security Contractor-installed projects of a similar size and scope in operation for at least (1) year. The Security Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- k) List of completed and ongoing projects with the Owner. The Security Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- The Security Contractor will provide Service contact information as well as rates and hours of operations.

1.9 General Requirements

- 1. The Security Consultant will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- 2. Proposed equivalent items must be approved in writing by the Security Consultant prior to installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- 3. In the event a manufacturer's specified product or part number has changed or is no longer available, the Security Contractor shall substitute the appropriate equivalent manufacturer's part number.
- 4. In the event of a discrepancy between the specifications and the drawings, the Security Contractor will provide and install the greater quantity and/or better-quality device.
- 5. For listed products with no part number specified, the Security Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- 6. All wiring, equipment, and installation materials shall be new and of the highest quality.
- 7. Labels on all wiring, materials, and equipment must indicate a nationally recognized testing laboratory.
- 8. Original Equipment Manufacturer (OEM) documentation must be provided to the Security Consultant which certifies performance characteristics and compliance with industry standards.
- 1.10 The following sections specifically list the acceptable equipment types and items for this project.

Acceptable Manufacturers

- 1. Access Control System Software/Hardware
 - a) Access Control Software (Approved Vendors)
 - 1) Open Options
 - 2) S2
 - 3) Avigilon
 - 4) Genetec
 - b) Access Control File Server
 - 1) Security Contractor provided. The Security Contractor will provide an option to provide a virtualized access control server onto Owner provided hardware (Software only)
 - c) Access Control System Controllers
 - 1) The latest Mercury LP Intelligent Controllers
 - 2) The latest Mercury MR serial Input/output (SIO) sub controllers
 - a) The Access Control system will operate in Open Supervised Device Protocol (OSDP) mode
 - d) Card Reader HID iCLASS SE®
 - 1) iCLASS SE R40 (Wall switch) 920NMNNEKMA001- Mobile Ready Version that supports OSDP
 - a) The card readers will operate in Open Supervised Device Protocol (OSDP) mode
 - e) Access Control Cards (Qty:100)
 - a) HID Global Card Part Number and Description: 2000PGGMV ICLASS 2K/2, PROG ICLASS, F-GLOSS, B-GLOSS, MATCH ICLASS #, VERT SLOT
 - b) Card Format: H10301 Description: STANDARD 26 BIT FORMAT (26 Bits)
 - c) Card Marking: MATCHING
 - d) FACILITY CODE Start# 207
 - e) The Security Contractors is to coordinate with the owner prior to ordering access cards regarding card numbering.
 - f) Request to Exit Device
 - 1) Bosch DS150i (white)
 - Or approved equal
 - g) Badge ID camera
 - 1) VALCam 8500-630 Pan Tilt & Zoom Camera/USB/cables/power supply and Aluminum Tripod (Multisection aluminum legs expand to 52)
 - a) Qty: 1
 - 2) Or approved equal
 - h) Electrified Locking Mechanisms/systems
 - Single door applications as noted on the security drawings shall be a Von Duprin 6113, 24 VDC Electric Strike, brushed stainless/fail secure operation.

- 2) Double door applications as noted on the security drawings shall be a Von Duprin Quiet electric latch retraction (QEL) no Hex Dogging option, US92 finish.
- 1) Or approved equal
- 3) The Security Contractor shall closely coordinate with the Architect and the Security Consultant to assure that the correct door hardware is provided and installed on the access-controlled doors noted on the security drawings.
- 4) The Security Contractor shall be responsible to provide the locking hardware power, terminations at the power supplies as well as at the locking devices. The Security Contractor shall also be responsible for control cabling/wiring (materials and installation) where required.
- i) Door Position Switches
 - Concealed/Surface Mounted Door Position Switch
 - a) GE/Sentrol 1076/1078/2700
 - b) Or approved equal
- j) Power supply/enclosure
 - a) LifeSafety Power-Mercury ProWire System, Dual voltage 12A/12V, 10A/24V, 8 and 16 doors, Panduit Wiring, (Networked) The network monitoring module shall provide the ability of remote functionality such as control, status reporting, remote battery testing, fault reporting / restore, and shall interface with multiple control and monitoring modules to extend the remote functionality to multiple individual outputs for direct control, and extended monitoring and information gathering. , Model numbers: FPO150/250-3D8P2M8NL4E8M2/P16 and FPO150-B1002D8PM8NL4E6M/P8
 - b) Or approved equal
- k) Tamper and locks
 - a) The Security Contractor shall provide and install tamper alarm switches and key locks on all security access control enclosures. The tamper switches will be installed and terminated onto an active and monitored alarm point. At the termination of the installation, the Security Contractor will provide three sets of panel keys to the owner per facility secured.
- I) Duress switch/Admin lock-down
 - a) HONEYWELL 269R
 - b) Or approved equal
- m) Access Control Composite Cable
 - Windy City Wire, part number 4461060 Access Control, UL Listed and Rated Type CMP Plenum Composite Cable. All new access control cabling shall have a green outer jacket.
 - 2) Additional access/security cabling that maybe required
 - a) Electric Strike 18 AWG / 4 Conductor Shielded Plenum Rated
 - b) Door Contact 18 AWG / 2 Conductor Shielded Plenum Rated
 - c) Door Management Device 18 AWG / 6 Conductor Shielded Plenum Rated
 - d) Push Button/Door Release 18 AWG / 4 Conductor Shielded Plenum Rated
 - e) Lock Down Switch 18 AWG / 4 Conductor Shielded Plenum Rated
 - 3) Or approved equal

- 2. Pathway Cable Support
 - a) Panduit J-Mod Cable Support System
 - b) Erico CADDY CAT LINKS J-Hook Series
 - c) Panduit Plenum Rated Hook & Loop (Black)
- 3. Labeling
 - a) Permanent Labels for Copper Cables (No Handwritten Labels)
 - 1) Panduit Self-Laminating Labels
- 4. Fire Stop
 - a) STI Spec Seal
 - b) 3M Products

PART 2 - EXECUTION

- 2.1 Codes, Standards, Regulations
 - 1. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (May 2001)
 - 2. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces (October 2004)
 - 3. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure (May 2002)
 - 4. SIA
 - 5. Local
 - 6. NEC
 - 7. ISO
 - 8. FCC
 - 9. UL
 - 10. OSHA
 - 11. NFPA
 - 12. NEMA
 - 13. Plenum Applications
 - 14. Applicable Flame Test: UL 910 (NFPA 262 1990).
- 2.2 General Requirements
 - The Security Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of
 Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Security
 Contractor identifies any item in the plans or specifications that will not strictly comply with the laws, ordinances, and
 rules, the matter shall be referred to the Security Consultant for direction before proceeding with that part of the work.
 - 2. In the event of any conflicts between documents referenced herein and the contents of this specification, the Security Contractor shall notify the Security Consultant in writing of any such occurrences before purchasing or installing any equipment or materials. The Security Consultant will notify the Security Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to design changes, equipment, materials and/or

installation changes. In any event the Security Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.

- 3. The Security Contractor shall install all materials in accordance with these specifications and the manufacturer's installation guidelines.
- 4. No deviations from the plans or specifications shall be made without full consent in writing from the Security Consultant. The Security Contractor shall have written approval from the Security Consultant for any additional work beyond the Contract Documents prior to beginning such work. If the Security Contractor does not obtain written approval from the Security Consultant prior to proceeding with the work, the Security Contractor shall not be reimbursed for the work.
- 5. The Security Contractor shall obtain written permission from the Owner and Security Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.
- 6. The Security Contractor shall notify the Security Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Security Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- 7. The Security Contractor shall maintain a work area free of debris, trash, empty wire reels, scrap wire, etc., and dispose of such items daily and return the site to the original state of cleanliness. The Security Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- 8. Equipment and materials installed by the Security Contractor shall be new and free of defects and damage. All devices shall be installed flush, level and plumb, no exceptions.
- 9. The Security Contractor shall be responsible for the repair of any damage caused to the building/property by the Security Contractor during the installation.
- 10. The Security Contractor shall test all security cable and wires prior to installation and provide a written report to the Security Consultant before final system testing is complete. By failing to perform this testing operation, the Security Contractor shall accept the wire as compliant and assume all liability for the replacement of the wire at no cost to the Owner should it be found defective later.
- 11. The Security Contractor shall maintain a set of working specifications, design drawings, and shop drawings to be always kept on site and shall update the shop drawings on a weekly basis as maybe required. Shop drawings shall be made available for inspection at the request of the Security Consultant.
- 12. The Security Contractor will assign a single project manager to the project. The Project Manager will be available to attend weekly construction status meetings (approx. 1-hour weekly meeting). The format of the weekly meetings shall include but not be limited to the following agenda items:
 - 1) Safety status report
 - 2) Summary of the past week's project status milestones/open/closed items/proposed resolutions
 - 3) Summary of the current project status/open/closed items/proposed resolutions
 - 4) A detailed report of the coming week's milestones/open/closed items/proposed resolutions
 - 5) A three-week project look-ahead, including any owner/consultant items provided items
 - 6) A QC/QA Summary report of items that were discovered and corrected
 - 7) An updated project construction schedule.
- 13. The Security Contractor's Project Manager will be the single point of contact between the Security Contractor (Company) and the Owner and Security Consultant. The Project Manager will coordinate and manage all aspects of the Security Contractor's scope of work related to this project. The Security Contractor's Project Manager will be available to meet with the Security Consultant Monday-Friday 0700 to 1700 CST.
- 14. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.

- 15. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Security Contractor's expense.
- 16. The Security Contractor shall make all stored equipment and materials available for inspection at the request of the Security Consultant Monday-Friday 0700 to 1700 CST.
- 17. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed. All outdoor devices will be installed with means and methods to prevent damage from the weather.
- 18. Wires/cabling shall be properly supported in accordance with industry standards at all times. Improperly supported wires shall be corrected by the Security Contractor at no cost to the Owner.
- 19. The Security Contractor will be responsible for suppling all the tools, labor, supplies, lifts, and any requirements needed to provide for the access control installation. The owner will not provide any tools, lifts, labor, etc.
- 20. If the Security Contractor is to operate any lift equipment on the owner's property, the Security Contractor will carry insurance and be responsible for any damages caused by the operation of the lift.
- 21. The Security Contractor shall be responsible to properly protect devices from damage by other trades during construction.
- 22. The Security Contractor will be responsible for any additional pathway/conduits systems required to support the installation of the access control system as part of the base bid.
- 23. All security system cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- 24. The Security Contractor shall not install wires in conduits or sleeves without nylon bushings. Wires installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
- 25. The Security Contractor will assure that all control panels/enclosures are properly earth grounded.

2.3 Installation

1. Coordination

- a) The Security Contractor will coordinate with the Owner and the Security Consultant to ensure that doors and door frames are properly prepared for new electric locking hardware and door position switches. The Security Contractor will notify the Owner and the Security Consultant of any existing door and/or door frame conditions that require the Owner to provide maintenance on the door(s).
- b) The Security Contractor will coordinate the provisioning of key cylinders and cores for all Security Access Control Enclosures with the Owner. Coordinate cylinder and master key requirements with the Owner, Security Consultants and related trades.
- c) The Security Contractor will coordinate the locations of all devices with the Security Consultant prior to installation.
- d) The Security Contractor will coordinate and verify the location of each piece of wall and/or rack mounted equipment with the Owner and the Security Consultant.
- e) The Security Contractor will coordinate all initial database partitioning, importing, exchange and setup with the Owner and the Security Consultant prior to initial programming and card holder data entry.
- f) The Security Contractor will coordinate finishes and colors of all equipment with the Owner and the Security Consultant. Submit all finish and graphics for all equipment in public areas to the Owner and the Security Consultant for approval prior to installation.
- g) The Security Contractor will coordinate with the Owner and the Security Consultant for the physical location of any server hardware or virtualized access control server. The Security Contractor is responsible for ensuring the virtual server meets the manufacturers "access control server" minimum specifications. If the server requirements are not compatible with the ACS manufactures requirements the Security Contractor will notify the Owner and Security Consultant in writing as soon as the information is known.

2. General

- a) The Access control system (ACS) shall consist of software, system workstations, and door controllers, and all other components as indicated on the Drawings and specified herein.
- b) The Security Contractor will verify acceptance of each type of specified request-to-exit hardware for each application with local life safety code officials, prior to installation.
- c) Verify fail-secure lock requirements with the Owner and the Security Consultant.
- d) Security Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.
- e) The Security Contractor shall provide and install security/tamper proof fasteners for all equipment which is in public areas.

3. Door Controls

- Electric Locks: Controls for lock, momentary unlock (preprogrammed for five second unlock time), timed unlock with selectable unlock time, and maintained unlock.
- b) The Security Contractor shall terminate each wall mounted lock down device, undercounter panic, undercounter door release and undercounter lock down device to a control point on the access control system as addressable control point.

4. Access Control

- a) Card reader and remote control of doors as indicated in the Security Drawings.
- b) Initial programing of the ACS will be provided by the Security Contractor in close coordination and oversight with the Owner and Security Consultant. The final ACS programming will be provided by the Owner after the Security Contractor has provide administrative system training to the Owners staff.

2.4 Equipment/software

- 1. Provide equipment as indicated on the drawings and specified herein. Additional specific installation requirements are as follows:
- 2. Server The Security Contractor should coordinate with the owner and Security Consultant for server location.
 - a) The Security Contractor shall provide and install the required server and workstation(s) hardware to meet the ACS software requirements. The ACS software and server shall meet the needs of this project and provide a minimum of 25% expansion for future needs of the owner.
 - b) As an option the Security Contractor shall provide ACS Software only to the owner, The Owner may elect to install the ACS software onto an owner provided server.

3. Control Panels

- a) All ACS and controller panels will provide communications protected by TLS 1.2/1.1 or AES-256/128.
- b) All ACS and controllers will support multiple card formats, paired and alternate readers, elevator, turnstile and biometric devices, Anti-pass back support (area, reader and time based), threat level and operating modes, Port based network access control using 802.1X, FIPS 140-2 user of OpenSSL, Building Control using BACnet IP. 5,000 cardholder capacity with a 50,000-transaction buffer. The ACS will support RS-485 IO protocols a min of 255 access levels per cardholder. The ACS controllers will provide cardholders 19 Digit (64 Bit), User ID with 15-digit PIN MAX Activation/Deactivation, If/Then macro capabilities, Nested, area, hard, soft and timed forgiveness, Adjustable cardholder capacity. The ACS and controllers will support up to 1024 inputs and 1024 outputs and shall carry a UL-294 rating.
- c) The ACS and controllers shall collect alarm input point status and access control data, multiplex the information, and transmit that data back to the access control system (ACS) System file server / system workstations.
- d) The controllers shall incorporate Flash ROM to allow for efficient firmware update downloads from the system software and/or remotely from the ACS System manufacturer.

- e) The control panels shall receive and execute instructions issued automatically or manually from the ACS System file server/system workstation.
- f) The control panels shall have memory and logic circuits as required to ensure continued operation of connected devices without degradation to the system if communications with the ACS System file server is interrupted.
- g) All system control panels shall communicate with the ACS System file server over an Owner provided communications IP network.
- h) The control panels shall also provide the following:
 - Supervised alarm inputs to monitor the status of alarm circuits and report the status information to the ACS System file server.
 - UL294 Recognized, FCC Part 15 Class A, CE Compliant, RoHS (2011/65/EU & 2015/863), EU REACH (1907/2006) and NIST Certified Encryption
 - 3) Control relay outputs for controlling devices by remote command from the ACS System workstations, through time programming or on alarm point activation. Control relay output contacts shall be rated for 2 A @ 24 VDC.
 - 4) Flash ROM technology shall provide for remote update of controller firmware.
 - 5) Supervision of all wiring/circuits between the Controllers and monitored alarm devices. Wire and device supervision shall meet UL 1076 guidelines.
 - 6) Enough RAM to maintain a minimum card database of 30,000 cards.
 - Automatic disconnection from the communication circuit upon a communication failure within the Controllers to prevent communication to other Controllers in the circuit from being interrupted.
 - 8) Enough RAM to operate normally upon loss of communication with the ACS System file server.
 - 9) Activation of a door control relay output and shunting of the intrusion alarm upon verification of a card authorization or request to exit.
 - 10) Adjustable door control relay activation time through ACS System Software from 1 to 30 seconds on an individual card reader basis, with all doors automatically relocking upon closure.
 - 11) An intrusion alarm indication on the ACS System if the card reader-controlled door is opened without an authorized card use or request to exit.
 - 12) A door prop alarm indication if the card reader-controlled door is held open past an adjustable time period after an authorized card use or request to exit. The door prop time delay shall be adjustable through ACS System Software from 1 to 60 seconds on an individual card reader basis.
- i) Transaction time for authorized cards shall be less than 0.5 second from the time of card read until the door is unlocked.
- j) The Security Contractor shall provide one spare card reader input point and 20 percent spare alarm input points and output point's after all specified points are initially connected per panel. Sufficient modules shall be provided to accommodate only the number of card readers initially installed, as well as one spare input per control panel at each communications closet or consolidation point.
- k) The Security Contractor shall configure the system such that devices can be connected to spare input points, output points and card reader inputs on the control panel without requiring reconfiguration of the ACS.
- I) The Security Contractor shall configure the control panel communication chains such that no more than 48 card readers (including all possible spare card readers) shall be connected to each control panel chain.
- m) Communications
 - 1) The Security Contractor shall closely coordinate with the owner on any LAN/network related issues and identify any network requirements as soon as possible (within 3 days of the discovery).

- Communications between servers, workstations, and control panel will be based on utilizing the Owner's LAN.
- 3) The ACS shall support 10 Base T Ethernet communications between the ACS File Server and the System Workstations, and between the ACS File Server and the control panel's.
- Communications shall be encapsulated in a TCP/IP network transport layer in a client / server type Architecture.

4. Access Control Software

- a) The security access control system software (ACS) shall be part of an all-encompassing unified security platform which shall support the seamless unification of access control system, alarm monitoring and IP video management system under a single software. The user interface (UI) applications shall present a unified security interface for the management, configuration, monitoring, and reporting of embedded security systems and associated edge devices.
- b) The ACS shall be based on an open architecture able to support multiple access control hardware manufacturers. The ACS shall be able to integrate with multiple non-proprietary interface modules and controllers, access readers, and other third-party applications.
- c) The ACS shall synchronize all access control hardware units under its control, such as door controllers and I/O modules. It shall also be able to validate and log all access activities and events when the door controllers and I/O modules are online.
- d) The ACS shall maintain the communication link with the hardware controllers under its control. It shall also continuously monitor whether the controllers are online or offline and report on any communication failures.
- e) Synchronization of hardware units shall be automated and transparent to users and shall occur in the background. It shall also be possible to manually synchronize units or to synchronize units on a schedule.
- f) The ACS shall support doors and controllers located within one or more facilities. The Access Server shall support a minimum of 2000 readers and shall store all access events associated with the doors, areas, hardware zones (hardware input points), elevators, and controllers under its direct control. The software shall support the discovery, configuration, and management of IP enabled controllers and I/O modules (hardware units). A user shall be permitted to add, delete, or modify a controller if they have the appropriate privileges. The ACS shall support unit configuration through a preconfigured door template. The ACS shall support automatic unit discovery. The user shall establish the settings for discovery ports and for the types of unit discovery and the ACS shall automatically detect all connected devices.
- g) The ACS shall support a unit swap utility for swapping out an existing controller with a new controller. The unit swap utility shall avoid the reprogramming of the system whenever a unit is replaced. All logs and events from the old unit shall be maintained.
- h) The ACS shall support the configuration and management of cardholders and cardholder groups. A user shall be able to add, delete, or modify a cardholder or cardholder group if they have the appropriate privileges.
 Custom fields shall be supported for both cardholders and cardholder groups.
- i) The ACS shall permit the following activation/expiration options for a cardholder's profile: delayed activation of a cardholder's profile, expiration based on the date of first use of credentials, or expiration on a user-defined date. The ACS shall be able to set a start date and expiration date for the association of a cardholder and an access rule for temporary access.
- j) Cardholder groups shall enable the grouping of cardholders to facilitate mass changes to system settings. It shall be possible to assign cardholder groups to access rules, thus avoiding the assignment of one cardholder at a time. It shall be possible to select multiple cardholders for immediate deactivation or reactivation.
- k) The ACS shall support the synchronization of cardholders and cardholders' group through Active Directory including the credentials and pictures of the cardholders. Batch enrollment of credentials shall be supported.
- The ACS shall provide role based access by location, reports including, but not limited to, active card holders, inactive card holders, record of changes of locations over time, last time card was used, reports by location, reports by type and auditing capability including, but not limited to details on changes made within the system and users who made them.

- m) At a minimum the ACS shall support an integrated import tool to facilitate the import of existing cardholder and credential data through the use the CSV file format. The tool shall be available from the Configuration UI. The import tool shall permit at a minimum the import of the following data:
 - 1) Cardholder name, descriptions, picture, email, and status.
 - 2) Cardholder group information.
 - 3) Credential name, status, format, and card number (including credentials with custom formats).
 - 4) Partition information.
 - 5) Custom fields.
 - 6) Activation date and expiration date.
 - 7) Update cardholder group association.
- The ACS shall natively support the creation and management of mobile IDs in the same way as other credentials.
- o) The ACS shall provide for a custom card format feature that will allow the administrator to add additional custom card formats using an intuitive tool within the Configuration UI. The custom card format tool shall be flexible in the following ways:
 - 1) An unrestricted number of additional custom card formats can be added.
 - Once enrolled, new custom card formats shall appear in the card format lists for manual card enrollment.
 - 3) Shall support credential with up to 256 bits.
 - 4) The administrator shall be able to set options when defining a new format such as:
 - a) The order in which card fields appear in the user interface
 - b) Whether a field is hidden from or visible to an operator.
 - c) Whether a field is read only or modifiable by an operator.
 - d) The order and location of a field's data.
- p) The (ACS) must have the following cybersecurity certifications:
 - 1) CSPN Certification from ANSSI
 - 2) UL 2900-2-3 Level 3 Cybersecurity Readiness Certification
 - 3) ISO/IEW 27001 Standard
 - 4) Microsoft Gold Certification
 - 5) DHS Safety Act Certification
- q) The security access control system software shall be an IP-enabled solution. All communication between the workstations, server and panels shall be based on standard TCP/IP protocol and shall use TLS encryption with digital certificates to secure the communication channel.
- r) The (ACS) shall be highly scalable to support configurations consisting of thousands of doors with facilities spanning multiple geographic areas, and shall support an unrestricted number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
- s) The security access control system software shall support native and off-the-shelf failover options: Directory failover, Access Manager failover, and Archiver failover. These failovers should all be software-based and not need any third-party hardware or software to work.

- t) OSDP Version 2 must be supported by the security access control system software manufacturer and can change an OSDP HID reader from multi-class to high frequency directly through that protocol.
- u) The security access control system software should be able to change the state of the entire security system (such as access control, video, access control, VoIP intercoms, alarm panel status) based off any event. Threat level activation shall be able to initiate the sharing of entities a separate enterprise not related to the initiating enterprise.
- v) The security access control system software shall utilize a system update service and a system availability monitor to notify the end-user of clients, workstations, and servers that are offline or need an upgrade. This service will utilize the latest information provided by the software manufacturer in an automated fashion. The update service should also notify the end-user if there is a published critical update to firmware for devices across the security enterprise.
- w) The security access control system software shall consist of a role-based architecture. Each role shall execute a specific set of tasks related to either core system, access control (ACS), alarm functions, among others.
- x) Installation shall be streamlined through the ability of the security access control system software to allow administrators to do the following:
 - 1) Activate and deactivate roles as needed
 - 2) Centralize role configuration and management
 - 3) Support remote configuration
 - 4) Move roles over from one administrator to another
 - 5) Roles without databases, such as The Federation feature, Active Directory, and Global Cardholder Management, shall support near real-time standby without any third-party failover software being required.
- y) The security access control system software must be capable of supporting unlimited card formats with Mercury controllers.
- z) The security access control system software shall have the capability to provide a real-time Cybersecurity score via an embedded hardening guide.
- aa) The security access control system software shall support comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields. The reporting task shall have the ability to display results through graphics, such as pie charts or bar graphs, without the need to have external reporting software. The software shall be customizable to provide reports for both criteria and layout built into the reporting engine.
- bb) The security access control system software shall be able to run a hardware inventory report which contains, but is not limited to:
 - 1) Unit type, manufacturer, product type (such as camera, access control, and so on), firmware, role in the system, IP address, MAC address, time zone, user, password strength, authentication scheme, security protocol, upgrade status, next upgrade, propose firmware version, and state.
- cc) The security access control software shall support DMP, DSC and BOSCH Intrusion panels. They should be able to arm/disarm zones for these directly from the monitoring UI, and the dynamic graphical map. The security access control software will have the capacity to trigger virtual inputs to a third-party intrusion panel via the third-party API.
- dd) The security access control software shall provide the ability to display any type of third-party entities integrated through an SDK and shall be able to select floor/level selection through a built-in mapping floor selector. The security access control software shall support CAD files, vector files, or GIS maps.
- ee) The security access control software shall be able to bring in intrusion and arm/disarm zones directly from the map and must be able to push the base map to a mobile application and have it display the associated entities on that map.

- ff) The client software application shall support multiple languages, including but not limited to the following:
 - 1) English, Spanish, French, Arabic, Mandarin Chinese, Russian, and Spanish

2.5 Pathway Cable Support

- 1. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
- 2. When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Security Contractor furnished and installed j-hooks or saddle straps.
- 3. No cable pathway shall exceed 40% fill ratio.
- 4. The Security Contractor shall furnish a separate i-hook or saddle strap pathway for each wire type.
- 5. J-hooks and saddle straps shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.
- 6. J-hooks shall be furnished with closure clips.
- 7. Maximum sag between supports shall not exceed twelve-inches (12").
- 8. The Security Contractor shall establish j-hook and saddle strap pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.

9. Cable Dressing

a) No nylon cable ties shall be used at any time during the installation of the system cabling. Only plenum rated Velcro hook & loop straps are authorized for use on this project.

b) Above Ceiling

- 1) Security Contractor shall furnish and install black plenum-rated hook & loop straps in plenum-rated airspaces.
 - a) The Security Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
 - b) The Security Contractor will be responsible for replace any ceiling tiles that maybe damaged in the process of working above the ceiling areas.

c) Security Controller Locations

- The Security Contractor shall bundle all visible wires with Security Contractor furnished and installed hook & loop straps.
- 2) Hook & loop straps shall be installed twenty-four (24) inches apart on center.

2.6 Labeling

- 1. Security Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels. The label shall be bold black letters/numbers not less than ½" high on a white background. The label shall have an adhesive backing and be legible when standing on the floor.
- 2. All security related panels, card readers, and other public facing security devices shall be labeled.
- 3. Cables shall be labeled within (2) inches from the termination point at the ACS panels/Power supplies located within the Equipment Room/Telecommunications/Security Control Location Rooms.
- 4. Cables shall be labeled within (2) inches from the termination point at the device end.
- 5. Cables shall be labeled with the device number and destination room number.
- Label all controls as necessary to agree with their function.

2.7 Fire Stop

Provide fire stop as required, consult with owner for arears requiring fire stop.

2.8 Wiring Techniques

- 1. Furnish and install all ACS wire and cable except for traveling cable for elevator control and monitoring.
- 2. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used for installation of the ACS.
- 3. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), electromagnetic interference (EMI), telephone, etc. with the Architect.
- Run all wire and cable continuous from device location to the final point of termination. No mid-run cable splices shall be allowed.
- 5. Wire and cable within Controllers, power distribution cabinets and other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to the equipment within the enclosure. All wire and cable shall be bundled and tied.
- 6. The Security Contractor will provide a wiring chart delineating wire routing, labeling, and all termination points. The chart shall be laminated and secured in a clear plastic sleeve affixed to the inside of the security access control enclosure.
- 7. No cable/wire splicing is permitted, however if the Security Contractor comes across a situation where a cable/wire splice is required, the location and means and methods of the propose splice will be presented to the Security Consultant in the form of an RFI. Provide heat-shrink to insulate all wire splices and connections. The use of electrical tape for splices and connections shall not be acceptable.
- 8. Visually inspect all wire and cable for faulty insulation prior to installation.
- 9. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on Wire and Cable.
- 10. Make connections with solderless devices, mechanically and electrically secured in accordance with the manufacturers' recommendations. Wire nuts shall not be an acceptable means of connecting wire and cable.
- 11. Neatly bundle and wrap all horizontally run (above accessible ceilings and not within conduit) wire and cable at three-meter intervals. Provide supports as required. All supports shall be UL listed for the application.
- 12. All system wiring within vertical riser shafts (as required) shall be bundled, wrapped and tied to the structure at three-meter intervals in order to isolate it from other wire and cable within the shaft. Additionally, all wire and cable within the shaft shall be supported at least every two floors using Greenlee Slack Grips (Split Mesh Lace Closing) or approved equal. Provide all personnel and equipment necessary to install and support the cable. All equipment shall be UL listed for the application.

2.9 Grounding and Bonding

General

- a) The Security Contractor shall ensure metal-to-metal contact for all terminations.
- b) All materials shall be UL Listed.
- c) All connections shall be made with UL Listed compression 2-hole lugs.
- d) Security Contractor shall use an anti-oxidation compound on all connections.
- e) In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.
- f) A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every 3rd floor in between).
- g) The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.
- h) Equipment Bonding Conductor (EBC)
 - 1) Security Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated conductor from the TMGB or TGB as applicable to each ladder rack system, equipment rack, cabinet, metallic raceway, lightning protector, or multi-pair cable with a metallic element. Security Contractor shall use an anti-oxidation compound on all connections.
 - When exceeding (13) feet the EBC shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.

2.10 Conduit, Boxes and Raceways

- Install all conduit necessary for a complete installation, but not provided for in the Security Conduit Drawings, in finished areas concealed in chases, furring's, concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
- 2. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, workmanlike installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
- 3. All conduit shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
- 4. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
- 5. Swab out and remove all burrs from conduit before any wires are pulled.
- 6. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
- 7. Provide fire stops where conduits penetrate fire rated walls and/or floors.
- 8. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

2.11 Power Requirements

 120VAC AC power dedicated to security shall be provided by the owner for the Security System as indicated on drawings. Coordinate with the Owner and Security Consultant to establish locations of security dedicated 120VAC AC circuits.

- 2. Hardwire connect Security Control panels to the AC power (provided by electrical Security Contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
- 3. Provide hinged cover terminal cabinets with tamper switches for all power supplies, transformers and power distribution terminal strips.
- 4. Surge Protection
 - a) Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
 - Protect all exterior video, control, power, signal cables and conductors against power surges. Each surge
 protector shall be UL Listed.

2.12 Labeled Doors and Frames

- 1. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.
- 2. The Security Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Owner/Security Consultant.

2.13 System Start-Up

- 1. All work related to the project shall be complete and ready to operate prior to system start-up.
- 2. The Security Consultant and Security Contractor shall coordinate in establishing procedural guidelines and in determining that the system is operational and ready for start-up.

2.14 Substantial Completion

- 1. In order to qualify for the Security Consultant's consideration of Substantial Completion, the Work must, at a minimum, meet the following requirements:
 - a) Installation of all devices must be completed.
 - b) All sub-system interfaces must be complete and operational.
 - c) The entire access control system must be operational i.e. card readers, door contact, request to exit devices and door lock power shall be fully operational.
- 2. Substantial Completion shall not be construed as final acceptance of the Work.

3. Training

- a) As part of the Substantial Completion process the Security Contractor shall provide direct ACS factory certified training on all aspects of the Access Control System to the Owner and their staff.
- b) The ACS training shall be conducted over a period of no less than 2 working days and shall be broken down into classes for: Administrators, Supervisors, Operators and In-house Technicians.
- c) The ACS factory training department will develop a training agenda and course of studies that will be submitted no less than 10 days prior to the substantial completion of the ACS for review and comment by the Security Consultant and Owner.
- d) The ACS training will cover all aspects of the operation and maintenance of the ACS. The Owner and staff will be trained in a classroom environment by the ACS factory. The training will cover general and detailed operations and maintenance as well as specific requirements that the Owner and staff may bring up during the training.
- e) The ACS training will include all training materials required to provide complete and comprehensive training on the operations and general care and maintenance of the system.
- f) At the end of the ACS training the Owner and staff will be proficient in the operations and general care and maintenance of the system. The Owner will determine that the factory training has met the needs of the owner

and if the training fails to meet the owner's needs, additional training will be provided at no additional cost to the owner.

2.15 System Acceptance

- 1. Final acceptance testing of the Work will be conducted by the Security Consultant and the owner.
- Before system acceptance testing by the Security Consultant can commence, The Security Contractor shall conduct a
 complete in-house QA/QC test of the entire Access Control Security System and provide the Security Consultant with
 a written report on the results of that test. During the QC/QA test the Security Contractor shall place the ACS in
 service mode and calibrate and test all equipment.
- 3. Following completion of the initial testing and correction of any noted deficiencies, the Security Contractor shall conduct a five-day burn-in test. The intent of the burn-in test shall be to demonstrate that the ACS is operational by placing it in near real operating conditions. During this period the ACS shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. The Security Contractor shall record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.
- 4. The Security Contractor shall deliver to the Security Consultant a detailed report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Security Consultant that the installed ACS has been calibrated, tested, and is fully functional as specified herein.
- Prior to any final acceptance testing, the Security Contractor shall submit two sets of preliminary (draft) Record
 Drawings to the Security Consultant. The preliminary Record Drawings are to be used by the Security Consultant to
 conduct the system final test.
- 6. Prior to the final acceptance test, the Security Contractor shall coordinate with Owner and Security Consultant for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Security Contractor's and its Subcontractors' tools, construction equipment, machinery and all surplus materials.
- 7. Upon written notification from the Security Contractor that the Security System is completely installed, integrated and operational, and the burn-in testing completed, the Security Consultant and owner will conduct a final acceptance test of the entire system.
- 8. During the final acceptance test by the Security Consultant and Owner the Security Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. All physical and functional requirements of the project shall be demonstrated and shown. This demonstration will begin by comparing "as built" conditions of the Security System to requirements outlined in the Specification, item by item. Following the Specification compliance review, all Security System head-end equipment will be evaluated.
- 9. The functionality of the various interfaces between systems will be tested.
- 10. Following the Security System head-end equipment and console review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.
- All equipment shall be on and fully operational during any and all testing procedures. Provide all personnel, equipment, and supplies necessary to perform all site testing. The Security Contractor shall provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the other will be required to demonstrate the function of each device. The Security Contractor shall supply at least two two-way radios for use during the test. A manufacturer's representative may be present on site to answer any questions that may be beyond the technical capability of the Security Contractor's employees, if the Security Contractor so elects or by specific request of the Security Consultant or Owner, at no charge to the Security Consultant or Owner.
- 12. Upon successful completion of the final acceptance test (or subsequent punch list retest) the Security Consultant will issue a letter of final acceptance.
- 13. The Security Contractor should be aware that the Security Consultant retains the right to suspend and/or terminate testing any time when the system fails to perform as specified. If it becomes necessary to suspend the test, all the Security Consultant fees and expenses related to the suspended test will be deducted from the Security Contractor's

retainage. Furthermore, in the event it becomes necessary to suspend the test, the Security Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Drawings. The Security Contractor shall supply the Security Consultant with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest. During the final acceptance test, no adjustments, repairs or modifications to the system will be conducted without the permission of the Security Consultant.

2.16 Project Closeout Documentation

- Owner/Maintenance manuals and related supplies
 - The Security Contractor shall provide the owner with three (3) sets of Operations/maintenance manuals.
 - b) The Security Contractor shall provide the owner with three (3) sets of keys to all the security enclosures. Each Key set and enclosure shall be clearly identified by number and location.
 - c) The Security Contractor shall provide the owner with any materials required to operate and maintain the ACS.

2. As-Built Drawings

- a) Drawings shall be provided to the Security Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Security Consultant.
- b) Three (3) sets of drawings depicting the condition of the access control system as installed.
- As-Built drawings shall be produced in AutoCAD 2010 or higher and provided in hardcopy and electronically in .dwg and PDF format.
- d) Hardcopy drawings shall be provided in the original size as issued by the Security Consultant.
- e) Drawings shall retain the formatting and title block of the original drawings as issued by the Security Consultant.
- f) Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, pathways, card reader locations and labeling scheme.

2.17 Spare Parts

- 1. Security Contractor to provide spare parts as indicated below:
 - a) (1) Surface mount card readers
 - b) (1) Concealed door contact
 - c) (1) REX PIR devices
- 2. The cost for these spare parts shall be included in the cost of project/proposal. Spare parts are to be turned over to the Owner for storage.

2.18 Contactor's Statement of Warranty

- Statement of warranty shall be provided to the Security Consultant at the time of substantial completion. Final
 payment will not be recommended until statement of warranty is received and approved by the Architect/Engineer.
- 2. The Security Contractor shall furnish a minimum of a one (1) year warranty of the system on all materials, labor and workmanship starting at final system acceptance by the Owner and Security Consultant.
 - a) The Security Contractor will be responsible to respond to warranty issues within no more than four (4) hours, and if the warranty condition is deemed to be an emergency by the owner the Security Contractor will be responsible to respond to emergency warranty issues within no more than one (1) hour from the time of notification. All warranty calls will have no cost to the owner.

- 2.19 One original and two copies of Security Contractor's SERVICE AND WARRRTY terms and conditions to include contact information (i.e. Security Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.
- 2.20 The Security Contractor shall provide as part of the base bid and any future change orders itemized listing of all labor, equipment and material required to meet the specifications for this section of work. This listing shall include Part Number, Description, Unit of Measure, Unit Cost, Quantity, Labor Cost, and Extended Cost and any taxes.

Part Number	Description	Unit of Measure	Unit Cost	Quantity	Labor Cost	Extended Cost
Total Equipment and Materials					\$	
Total Labor and Installation					\$	
Grand Total					\$	

END OF SECTION 28 13 00

SECTION 28 1600

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

- This section identifies the requirements, technical design, and specifications for the intrusion detection system for Texas Department of Parks and Wildlife-Tyler State Park located in Tyler, Texas. The intrusion detection system as specified shall be a commercially available, industry-standard product and include control panels, keypad, glass break sensors, motion sensors, electronic siren, and intrusion detection cabling as specified The intrusion detection system shall include all devices, materials and labor to provide a complete and functional intrusion detection system. The intrusion detection system includes, control panels, keypad, motion sensors, electronic siren, and intrusion detection cabling door position sensors, cabling and pathways/conduit systems, this system shall be provided to the owner as a fully functional intrusion detection systems, with no exceptions.
- In the execution of this work, the Security Contractor shall comply with the requirements of local laws and ordinances, the laws of the State of Texas, the National Board of Fire Underwriters, OSHA, accepted industry standards and the National Electrical Code. If, in the opinion of the Security Contractor, there is anything in the specifications that will not strictly comply with the above laws, ordinances, and codes, the matter shall be referred to the Security Consultant for a decision before proceeding with that part of the work.
- 1.3 The Security Contractor shall include materials, equipment, and labor necessary to provide a complete and fully functional intrusion detection system regardless of any items not listed or described in this specification or associated drawings.
- 1.4 The Security Contractor and employees shall be factory trained and hold a certification for the intrusion detection system proposed to be installed for this project. The Security Contractor shall be and authorized distribution and integration partner of the proposed system(s) prior to submitting a proposal for this work.
- 1.5 The Security Contractor shall submit a clear and legible copy of the company's certificates and applicable licensing of the proposal response as part of their proposal. Failure to include this information may result in DISQUALIFICATION of the Security Contractors response documents.
- 1.6 Requirements
 - A. Security Contractor Experience Requirements
 - B. Submittal Requirements
 - C. Acceptable Manufacturers
 - D. Codes, Standards and Regulations
 - E. General Requirements
 - F. System Requirements
 - G. Testing Requirements
 - H. Training Requirements
 - I. Project Closeout Documentation
 - J. Attachments
- 1.7 Related Requirements
 - A. The Drawings, Specifications, General Conditions, Technical Appendix, Supplementary General Conditions, and other requirements of the Owners bid documents apply to the work specified herein Division 28 Intrusion detection system and shall be complied with in every respect. The Security Contractor shall examine all the items which make up the Contract Documents and shall coordinate the requirement to the proposed scope of work for this project.
 - B. Security Contractor Experience Requirements
 - 1. The Security Contractor shall possess all relevant Manufacturer Certifications (i.e. hardware installation, software installation and programming, etc.) for both the company and individual technicians prior to submitting a bid for the work. The Security Contractor shall provide proof of this requirement as part of their proposal.

- 2. The Security Contractor shall have been in the electronic security business for a minimum of five (5) years and provide proof of this requirement as part of their proposal.
- 3. The Security Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of Tyler State Park.
- 4. The Security Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- 5. The security Contractor and any subcontractors involved in the installation of the system shall maintain a State of Texas, Department of Public Safety private security license for the sales/installation and service of security system for the full duration of the project. Each employee of the company shall maintain a State of Texas, Department of Public Safety private security license duration of the project. The owner may at any time during the installation ask to see a copy of the company's and/or individual employees the State of Texas, Department of Public Safety private security licenses.
- All Sub Contractors and their scope of work shall be identified at the time of bid. All Sub Contractors will fully comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.8 Submittal Requirements

A. Pre-Installation Submittal

- 1. The Security Contractor shall not order, purchase, or install any equipment/software until pre-installation submittals have been accepted in writing by the Security Consultant and Owner. The Security Contractor shall submit a complete pre-installation submittal package as described herein to the Security Consultant for review within 20 business days of award of contract. The Pre-installation submittals shall include at a minimum the following items:
- 2. Manufacturer product data sheets for each proposed system component.
 - The Security Contractor shall provide product data sheets, products containing more than one (1) part number or product, the Security Contractor shall clearly identify the specific part number or product being submitted. Equipment schedules listing all system components, the manufacturer, model number and quantity of each shall also be included in the submittal package.
- 3. Shop drawings of the proposed system installation.
 - 1) As part of the Pre-Installation Submittal the Security Contractor shall provide Shop drawings that will include keypad locations, door position sensor locations, intrusion detection panel elevations to include layout of all devices, power supply locations, complete installation details, preliminary cabling numbering strategy, proposed cable pathways, complete system schematics, and riser diagrams. The Shop drawings shall be submitted on 30" X 42" bond paper.
 - 2) The Security Contractor shall always maintain a set of shop drawings on site and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Security Consultant.
 - 3) As part of the Pre-Installation Submittal, the Security Contractor will provide a Gantt Chart construction schedule. The Security Contractor will maintain an accurate construction schedule throughout the project and share the construction schedule with the owner's project management team during a weekly project status meeting.
 - a) The construction schedule shall at a minimum include:
 - 1. Critical path
 - 2. Longest path
 - 3. Milestones
 - 4. Activity Float and Schedules
 - 5. Critical path for fabrication of devices/systems
 - 6. The Responsibilities of the Parties

- 4. Manufacturer Product Certifications for Company.
- 5. Manufacturer Product Certifications for Installers.
- 6. Manufacturer Warranty letter.
- 7. Documentation indicating that Security Contractor has been in business for (5) years.
- 8. Address of Security Contractor's local office within a 75-mile radius of the project site.
- 9. Quantity of full-time local technicians within a 75-mile radius of the project site.
- 10. List of five (5) Security Contractor-installed projects of a similar size and scope in operation for at least (1) year. The Security Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- 11. List of completed and ongoing projects with the Owner. The Security Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
- 12. The Security Contractor will provide Service contact information as well as rates and hours of operations.

1.9 General Requirements

- A. The Security Consultant will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- B. Proposed equivalent items must be approved in writing by the Security Consultant prior to installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- C. In the event a manufacturer's specified product or part number has changed or is no longer available, the Security Contractor shall substitute the appropriate equivalent manufacturer's part number.
- D. In the event of a discrepancy between the specifications and the drawings, the Security Contractor will provide and install the greater quantity and/or better-quality device.
- E. For listed products with no part number specified, the Security Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- F. All wiring, equipment, and installation materials shall be new and of the highest quality.
- G. Labels on all wiring, materials, and equipment must indicate a nationally recognized testing laboratory.
- H. Original Equipment Manufacturer (OEM) documentation must be provided to the Security Consultant which certifies performance characteristics and compliance with industry standards.
- 1.10 The following sections specifically list the acceptable equipment types and items for this project.

Acceptable Manufacturers

- A. Intrusion detection System Software/Hardware-Digital Alarm Communicator System (DCAS)
 - 1. Approved manufactures
 - 1) Bosch
 - 2) DMP
 - 3) DSC (Digital Security Controls)
 - 2. Intrusion detection control panel (Approved Vendors)
 - 1) Bosch B9512G panel
 - 2) Or approved equal

- 3. Intrusion keypad
 - 1) Bosch B921C Capacitive Touch Keypad
 - 2) Or approved equal
- 4. Motion Detectors
 - 1) Bosch ISC-PDL1W18G Professional Series PIR & MW Wall Mounted Motion Detector.
 - 2) Bosch DS9370 Ceiling Mounted PIR & MW Motion Detector.
 - 3) Bosch ISC-CDL1-W15- Long Range PIR & MW Motion Detector
 - 4) Bosch # B328-Swivel mounts wall mounts
- Door Position Switches
 - 1) Concealed/Surface Mounted Door Position Switch
 - a) GE/Sentrol 1076/1078/2700
 - b) Or approved equal
- 6. Glass Break Sensors
 - a) DS1108i Glass break Detector
 - b) Or approved equal
- 7. Tamper and locks
 - a) The Security Contractor shall provide and install tamper alarm switches and key locks on all security intrusion detection enclosures. The tamper switches will be installed and terminated onto an active and monitored alarm point. At the termination of the installation, the Security Contractor will provide three sets of panel keys to the owner per facility secured.
- 8. Intrusion detection Cable
 - 1) Belden 6504FE Security, Plenum-CMP, 6-22 AWG
 - 2) Belden 6502FC Security, 4 Conductor 22 AWG BC, Shielded, Plenum
 - 3) Belden 6300UE 18 AWG 2 Conductor Unshielded, CMP Plenum
 - 4) Belden 6302UE 18 AWG 4 Conductor Unshielded, CMP Plenum
 - 5) all system cable shall be plenum rated.
 - 6) Or approved equal
- B. Pathway Cable Support
 - 1. Panduit J-Mod Cable Support System
 - 2. Erico CADDY CAT LINKS J-Hook Series
 - 3. Panduit Plenum Rated Hook & Loop (Black)
- C. Labeling
 - 1. Permanent Labels for Copper Cables (No Handwritten Labels)
 - 1) Panduit Self-Laminating Labels

- D. Fire Stop
 - 1. STI Spec Seal
 - 2. 3M Products

PART 2 - EXECUTION

- 2.1 Codes, Standards, Regulations
 - A. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (May 2001)
 - B. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces (October 2004)
 - C. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure (May 2002)
 - D. SIA
 - E. Local
 - F. NEC
 - G. ISO
 - H. FCC
 - I. UL
 - J. OSHA
 - K. NFPA
 - L. NEMA
 - M. Plenum Applications
 - N. Applicable Flame Test: UL 910 (NFPA 262 1990).
- 2.2 In the event of any conflicts between documents referenced herein and the contents of this specification, the Security Contractor shall notify the Security Consultant in writing of any such occurrences before purchasing or installing any equipment or materials. The Security Consultant will notify the Security Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event the Security Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.
- 2.3 General Requirements
 - A. The Security Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Security Contractor identifies any item in the plans or specifications that will not strictly comply with the laws, ordinances, and rules, the matter shall be referred to the Security Consultant for direction before proceeding with that part of the work.
 - B. The Security Contractor shall install all materials in accordance with these specifications and the manufacturer's installation guidelines.
 - C. No deviations from the plans or specifications shall be made without full consent in writing from the Security Consultant. The Security Contractor shall have written approval from the Security Consultant for any additional work beyond the Contract Documents prior to beginning such work. If the Security Contractor does not obtain written approval from the Security Consultant prior to proceeding with the work, the Security Contractor shall not be reimbursed for the work.

- D. The Security Contractor shall obtain written permission from the Owner and Security Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.
- E. The Security Contractor shall notify the Security Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Security Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- F. The Security Contractor shall maintain a work area free of debris, trash, empty wire reels, scrap wire, etc., and dispose of such items daily and return the site to the original state of cleanliness. The Security Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- G. Equipment and materials installed by the Security Contractor shall be new and free of defects and damage. All devices shall be installed level and plumb.
- H. The Security Contractor shall be responsible for the repair of any damage caused to the building/property by the Security Contractor during the installation.
- I. The Security Contractor shall test all security cable and wires prior to installation and provide a written report to the Security Consultant before final system testing is complete. By failing to perform this testing operation, the Security Contractor shall accept the wire as compliant and assume all liability for the replacement of the wire at no cost to the Owner should it be found defective later.
- J. The Security Contractor shall maintain a set of working specifications, design drawings, and shop drawings to be always kept on site and shall update the shop drawings on a weekly basis as maybe required. Shop drawings shall be made available for inspection at the request of the Security Consultant.
- K. The Security Contractor will assign a single project manager to the project. The Project Manager will be available to attend weekly construction status meetings (approx. 1-hour weekly meeting). The Project Manager will be the single point of contact between the Security Contractor and the Security Consultant. The Project Manager will coordinate and manage all aspects of the Security Contractor's scope of work related to this project. The Security Contractors Project Manager will be available to meet with the Security Consultant Monday-Friday 0700 to 1700 CST.
- L. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- M. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Security Contractor's expense.
- N. The Security Contractor shall make all stored equipment and materials available for inspection at the request of the Security Consultant Monday-Friday 0700 to 1700 CST.
- O. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed. All outdoor devices will be installed to prevent damage from the weather.
- P. Wires/cabling shall be properly supported in accordance with industry standards at all times. Improperly supported wires shall be corrected by the Security Contractor at no cost to the Owner.
- Q. The Security Contractor will be responsible for all tools, labor, lifts, and any requirements needed to provide and install a turn-key security intrusion detection installation.
- R. The Security Contractor shall be responsible to properly protect devices from damage by other trades during construction.
- S. The Security Contractor will be responsible for any pathway/conduits systems required to support the installation of the intrusion detection system as part of the base bid.
- T. All security system cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- U. The Security Contractor shall not install wires in conduits or sleeves without nylon bushings. Wires installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.

V. The Security Contractor will assure that all control panels/enclosures are properly earth grounded.

2.4 Installation

A. Coordination

- The Security Contractor will closely coordinate with the Security Consultant/Owner to ensure that adequate power has been provided and properly located for the security system equipment where existing intrusion detection panels are being removed and new intrusion detection panels are being installed.
- 2. The Security Contractor will coordinate with the Owner and the Security Consultant to ensure that doors and door frames are properly prepared for new door position switches. The Security Contractor will notify the Owner and the Security Consultant of any existing door and/or door frame conditions that require the Owner to provide maintenance on the door(s).
- 3. The Security Contractor will coordinate the provisioning of key cylinders and cores for all Security Intrusion detection enclosures with the Owner. Coordinate cylinder and master key requirements with the Owner, Security Consultants and related trades.
- The Security Contractor will coordinate the locations of all devices with the Security Consultant prior to installation.
- 5. The Security Contractor will coordinate and verify the location of each piece of wall and/or rack mounted equipment with the Owner and the Security Consultant.
- 6. The Security Contractor will coordinate all initial to initial programming, importing, exchange and setup with the Owner and the Security Consultant prior to initial programming and data entry.
- 7. The Security Contractor will coordinate finishes and colors of all equipment with the Owner and the Security Consultant. Submit all finish and graphics for all equipment in public areas to the Owner and the Security Consultant for approval prior to installation.

B. General

- The Digital Alarm Communicator System (DCAS) shall consist of controllers, and all other components as indicated on the Drawings and specified herein.
- 2. Security Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.
- The Security Contractor shall provide and install security/tamper proof fasteners for all equipment which is in public areas.

2.5 Equipment/software

- A. Provide equipment as indicated on the drawings and specified herein. Additional specific installation requirements are as follows:
 - The DCAS shall include a Control Panel with built-in Ethernet jack for event communication and remote services.
 - 2. The DCAS shall be capable of storing up to 1000 events
 - 3. The DCAS shall be capable of storing up to 256 events
 - 4. The DCAS shall be capable of storing up to 128 events
 - 5. The DCAS shall include a Control Panel with an optional, supervised telephone line interface module.
 - 6. The DCAS shall include recording and retention of event information in a dedicated event log.
 - 7. The DCAS shall incorporate an integral real-time clock, calendar, and a test timer.
 - 8. The DCAS shall incorporate battery charging capabilities with supervision of battery voltage and battery leads.
 - 9. The DCAS shall accommodate a time / event-based scheduling system.

- 10. The DCAS shall be capable of supervision of peripheral devices and communications interfaces.
- 11. The DCAS shall accommodate configuration and operation of separate, independent areas.
- 12. The DCAS shall accommodate hard-wired or wireless point expansion via eight-point interface modules and RF receivers.
- 13. The DCAS shall have electrically supervised detection loops and power supplies with battery(s) maintenance. This supervision shall be programmable for the purposes of reporting this information to the DACR.
- 14. The DCAS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
- 15. The DCAS shall be able to accommodate test, diagnostics, and configuration programming functions locally or remotely via a portable programmer or a computer running the Remote Programming Software (RPS).
- 16. The DCAS shall annunciate alarm, trouble, service reminders, and other relevant system status messages in custom English, Latin American Spanish and/or French-Canadian text at the ACC.
- 17. The DCAS shall meet the following requirements:
 - 1. UL 50 Enclosures for Electrical Equipment.
 - 2. UL 294 Control System Units.
 - 3. UL 365 Police Station Connected Burglar Alarm Units and Systems.
 - 4. UL 609 Local Burglar Alarm Units and Systems.
 - 5. UL 985 Household Fire Warning System Units.
 - 6. UL 1023 Household Burglar Alarm System Units.
 - 7. UL 1076 Proprietary Burglar Alarm Units and Systems
 - 8. UL 1610 Central Station Burglar-Alarm Units.
 - 9. UL 60950-1 Information Technology Equipment Safety.
 - 10. UL 636 Hold up alarms
- B. The DCAS shall provide a fully integrated intrusion control system. The control panel shall support the following:
 - a. The DCAS system is capable of being utilized as a combination Intrusion and residential Fire system per code. Fully integrated intrusion and fire functions allow users to interface with 1 system instead of 2
 - b. Optional Telephone Line Module, programmable for signaling and supervision.
 - c. Integrated Conettix IP based communication provides high-speed, secure alarm transport and control.
 - d. 4 programmable areas with perimeter and interior partitioning.
 - 8 on-board, hardwired points with expansion capability for a total of 48 using a combination of wired or wireless points.
 - f. Compatibility with ATM style LCD or 2-line LCD style Alarm Command Centers.
 - g. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 - h. The system shall include an integrated USB port for local programming and diagnostics using a computer running Remote Programming Software (RPS) and standard male USB2.0 to male USB 2.0 cable with no additional hardware modules required.
 - i. The system shall support the use of an Apple iOS device for control. Functions to include arming, disarming and control of outputs. This application shall connect directly to the DCAS using internet, Wi-Fi or cellular communications and shall not require a third-party server of network operations center (noc).
 - j. The system shall offer multiple language support that can be assigned per keypad. Languages supported must include English, Latin American Spanish, Portuguese, Canadian French, Hungarian, Greek, Italian, Polish and/or Chinese.
 - k. The DCAS shall support flash firmware upgrades of systems firmware for the control panel and peripherals, allowing for future updates.
 - I. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control

- and automatic execution of system functions based on a time / event.
- m. Provide 0.8 amps of power for standby operation and 1.3 amps of alarm power, both rated at 12 VDC.
- n. 1 configurable form 'C' wet-contact relay outputs and 2 Auxiliary wet-contact solid state output with expansion capability for up to an additional 40 dry-contact relay outputs.
- Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
- p. Supervision of peripheral devices and communications interface(s).

B. Point Functionality and Expansion:

- 1. Each point in the system shall be programmable to provide the following type of response in the system:
 - a. Always on (24-hour response).
 - b. On when the system is Master Armed.
 - c. Only on when the system is Perimeter Armed.
 - d. Displays / Does Not Display at the ACC when the point is activated.
 - e. Provides / Does Not Provide entry warning tone.
 - f. Sounds / Does Not Sound audible alarm indication.
 - g. The Point is by-passable / not by-passable.
 - h. Alarm Verification with programmable verification time.
 - i. Relay activation by Point.
 - j. Provides / Does Not Provide "watch point" capability.
 - k. Provides Swinger Bypass.
 - I. Defers Bypass Report.
 - m. Can return to the system after being force armed and then restoring.
 - n. Can return to the system after being bypassed and then restoring.
 - o. Key switch arming (maintained or momentary)
 - p. Activate a Custom Function
 - q. Activate following an output
 - r. Gas Alarm
 - s. Monitor Delay/Delay response: included programmable response time of up to 60 minutes for monitoring propped doors or other properties
- 2. The DCAS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
- 3. The DCAS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds. The DCAS shall have the capability to expand up to 96 separately identifiable points, of which 8 are on-board and 88 are off-board wired or wireless points.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
- 1. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet. The DCAS shall have the capability to expand up to 48 separately identifiable points, of which 8 are on-board and 40 are off-board wired or wireless points.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
 - b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet. The DCAS shall have the capability to expand up to 28 separately identifiable points, of which 8 are on-board and 20 are off board wired or wireless points.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
 - b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.

2.

B. Areas/Accounts:

- 1. The DCAS shall be capable of assigning 1 to 4 account identifiers to the areas depending on the distribution of areas per account.
- 2. The DCAS shall be capable of assigning 1 to 2 account identifiers to the areas depending on the distribution of areas per account.
- 3. All the areas must be capable of Master (All) and/or Perimeter (Part) arming (excluding predefined Interior protection).

- 4. The DCAS shall be capable of logically grouping 1 or more points into an area, or conversely, dividing 2 or more points into two or more areas.
- 5. Any area shall be configurable to allow arming by specific users when a programmable number of devices are faulted or bypassed.
- 6. Areas shall be independently controlled by their corresponding ACC.
- 7. Area(s) shall accommodate assignment of independent account numbers to define annunciation, control, and reporting functions.
- 8. The DCAS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
- 9. The DCAS shall accommodate conditional area arming dependent on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.
- 10. Areas shall have an optionally programmable re-arm time to ensure that an area has not been left unprotected.
- 11. The DCAS shall be capable of activating 24 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module
- 12. The DCAS shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based.
- 13. Relays and other outputs may be programmed to follow up to 14 different area conditions or up to 12 panel conditions. Relays may also be programmed to follow individual points or groups of points.
- 14. The DCAS shall support 4 different types of alarm output selections: Steady, Pulsed, California Standard, and Temporal Code 3.
- 15. The DCAS shall support scheduling capabilities with the following characteristics:
- 16. Arm / Disarm specific area(s) based on open/close windows.
- 17. Bypass / Unbypass point(s).
- 18. Activate / Deactivate relay(s).
- 19. Send test reports.
- Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.
- 21. Automatic adjustment of system clock for daylight savings time.

C. Communication:

- 1. The DCAS shall be capable of communicating via dial-up analog telephone lines, over a LAN/WAN/Internet using a wired network interface module, or over a cellular network using a CDMA Cellular interface module. The DCAS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's. The following features shall be supported.
- 2. The DCAS communications format shall be utilized for optimum system performance. The ModemIIIa² format provides the maximum data information to the receiver for alarms, troubles, restorals, bypasses, relay activation, opening/closings, and card access. The detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information. As an alternative format, Contact ID may be used when a non-Bosch receiver is used although it will include less detailed information like point or user text.
- 3. The DCAS shall be capable of sending text (SMS) messages to compatible devices without requiring these messages are sent to a monitoring center
- 4. The DCAS shall have the capability of communicating with up to 8 different DACRs using up to 4 different phone numbers, up to 24-digits in length and/or 4 URL/IP addresses over a network.
- 5. The DCAS shall report to a Commercial Central Station that is using a Bosch D6600 Receiver/Gateway or a Bosch D6100i Receiver using Modem4 as a preferred format or Contact ID as an alternate format.
- 6. The DACR shall provide the transmission information sent from the DCAS that includes alarms, troubles, restorals, bypasses, relay activation, opening/closings, and card access. When using the ModemIIIa² format the detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information.
- 7. The DCAS reports shall be classified, by event, into eleven subcategories or "report groups." Each group represents similar types of events. Individual events within each group shall be selectively enabled or disabled for transmission. The eleven report groups shall be as follows:
 - a. Fire Reports.
 - b. Burglar Reports.
 - c. User Reports.

- d. Test Reports.
- e. Diagnostic Reports.
- f. Relay Reports.
- g. Auto Function Reports.
- h. RPS Reports.
- i. Point Reports.
- j. User Change Reports.
- k. Access Reports.
- 8. The DCAS shall be have the capability to verify the integrity of the remote communications path and switch to alternate paths when a communications failure occurs.
- 9. The DCAS shall be capable of unattended mode of operation whereby programming and configuration updates are automatically transferred using the Remote Programming Software (RPS). These updates can initiate from either the control panel or the remote computer using RPS.

D. Network Communication:

1. The DCAS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication. The notification options shall be programmable and include local annunciation or indication to automation software. The network interface module shall be capable of supporting Dynamic Host Communication Protocol (DHCP) to obtain an IP Address.

2.6 Pathway Cable Support

- A. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
- B. When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Security Contractor furnished and installed j-hooks or saddle straps.
- C. No cable pathway shall exceed 40% fill ratio.
- D. The Security Contractor shall furnish a separate j-hook or saddle strap pathway for each wire type.
- E. J-hooks and saddle straps shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.
- F. J-hooks shall be furnished with closure clips.
- G. Maximum sag between supports shall not exceed twelve-inches (12").
- H. The Security Contractor shall establish j-hook and saddle strap pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.
- I. Cable Dressing
 - 1. No nylon cable ties shall be used at any time during the installation of the system cabling. Only plenum rated Velcro hook & loop straps are authorized.
 - 2. Above Ceiling
 - 1) Security Contractor shall furnish and install black plenum-rated hook & loop straps in plenum-rated airspaces.
 - a) The Security Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
 - 3. Security Controller Locations

- The Security Contractor shall bundle all visible wires with Security Contractor furnished and installed hook & loop straps.
- 2) Hook & loop straps shall be installed twenty-four (24) inches apart on center.

2.7 Labeling

- A. Security Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.
- B. All security related panels, Keypads, and other public facing security devices shall be labeled.
- C. Cables shall be labeled within (2) inches from the termination point inside the Equipment Room/Telecommunications/Security Control Location Rooms.
- D. Cables shall be labeled within (2) inches from the termination point at the device end.
- E. Cables shall be labeled with the cable number and destination room number.
- F. Label all controls as necessary to agree with their function.

2.8 Fire Stop

A. Provide fire stop as required, consult with owner for arears requiring fire stop.

2.9 Wiring Techniques

- A. Furnish and install all DCAS wire and cable except for traveling cable for elevator control and monitoring.
- B. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used for installation of the DCAS.
- C. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), electromagnetic interference (EMI), telephone, etc. with the Architect.
- D. Run all wire and cable continuous from device location to the final point of termination. No mid-run cable splices shall be allowed.
- E. Where splicing and/or patching of coaxial cable is deemed necessary, it shall be accomplished through equalization and/or distribution amplifiers. Provide power for the amplifiers as required. The exact location of all equalization/distribution amplifiers (as applicable) shall be indicated on the Record Drawings.
- F. Wire and cable within Controllers, power distribution cabinets and other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to the equipment within the enclosure. All wire and cable shall be bundled and tied.
- G. Provide heat-shrink to insulate all wire splices and connections. The use of electrical tape for splices and connections shall not be acceptable.
- H. Visually inspect all wire and cable for faulty insulation prior to installation.
- I. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on Wire and Cable.
- J. Make connections with solderless devices, mechanically and electrically secured in accordance with the manufacturers' recommendations. Wire nuts shall not be an acceptable means of connecting wire and cable.
- K. Neatly bundle and wrap all horizontally run (above accessible ceilings and not within conduit) wire and cable at three-meter intervals. Provide supports as required. All supports shall be UL listed for the application.
- L. All system wiring within vertical riser shafts (as required) shall be bundled, wrapped and tied to the structure at three-meter intervals in order to isolate it from other wire and cable within the shaft. Additionally, all wire and cable within the shaft shall be supported at least every two floors using Greenlee Slack Grips (Split Mesh Lace Closing) or approved equal. Provide all personnel and equipment necessary to install and support the cable. All equipment shall be UL listed for the application.

2.10 Grounding and Bonding

A. General

- 1. The Security Contractor shall ensure metal-to-metal contact for all terminations.
- All materials shall be UL Listed.
- 3. All connections shall be made with UL Listed compression 2-hole lugs.
- 4. Security Contractor shall use an anti-oxidation compound on all connections.
- 5. In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.
- 6. A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every 3rd floor in between).
- 7. The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.
- 8. Equipment Bonding Conductor (EBC)
 - 1) Security Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated conductor from the TMGB or TGB as applicable to each ladder rack system, equipment rack, cabinet, metallic raceway, lightning protector, or multi-pair cable with a metallic element. Security Contractor shall use an anti-oxidation compound on all connections.
 - When exceeding (13) feet the EBC shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.

2.11 Conduit, Boxes and Raceways

- A. Install all conduit necessary for a complete installation, but not provided for in the Security Conduit Drawings, in finished areas concealed in chases, furring's, concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
- B. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, workmanlike installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
- C. All conduit shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
- D. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
- E. Swab out and remove all burrs from conduit before any wires are pulled.
- F. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
- G. Provide fire stops where conduits penetrate fire rated walls and/or floors.
- H. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

2.12 Power Requirements

A. 120VAC AC power dedicated to security shall be provided by the owner for the DCAS as indicated on drawings.

Coordinate with the Owner and Security Consultant to establish locations of security dedicated 120VAC AC circuits.

- B. Hardwire connect DCAS Security Control panels to the AC power (provided by electrical Security Contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
- C. Provide hinged cover terminal cabinets with tamper switches for all power supplies, transformers and power distribution terminal strips.

D. Surge Protection

- 1. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
- 2. Protect all exterior alarm, control, power, signal cables and conductors against power surges. Each surge protector shall be UL Listed.

2.13 Labeled Doors and Frames

- A. In no instance shall any UL labeled door or frame be drilled, cut, penetrated, or modified in any way.
- B. The Security Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Owner/Security Consultant.

2.14 System Start-Up

- A. All work related to the project shall be complete and ready to operate prior to system start-up.
- B. The Security Consultant and Security Contractor shall coordinate in establishing procedural guidelines and in determining that the system is operational and ready for start-up.

2.15 Substantial Completion

- A. In order to qualify for the Security Consultant's consideration of Substantial Completion, the Work must, at a minimum, meet the following requirements:
 - 1. Installation of all devices must be completed.
 - 2. All sub-system interfaces must be complete and operational.
 - 3. The entire intrusion detection system must be operational i.e. control panels, door contact, keypads and motion detectors shall be fully operational.
- B. Substantial Completion shall not be construed as final acceptance of the Work.

C. Training

- 1. As part of the Substantial Completion process the Security Contractor shall provide factory certified training on all aspects of the Intrusion detection System to the Owner and their staff.
- The DCAS training shall be conducted over a period of no less than 1 working day and shall be broken down into classes for: Administrators, Supervisors, Operators and In-house Technicians.
- The DCAS factory training department will develop a training agenda and course of studies that will be submitted no less than 30 days prior to the substantial completion of the DCAS for review and comment by the Security Consultant and Owner.
- 4. The DCAS training will cover all aspects of the operation and maintenance of the DCAS. The Owner and staff will be trained in a classroom environment by the DCAS factory. The training will cover general and detailed operations and maintenance as well as specific requirements that the Owner and staff may bring up during the training.
- 5. The DCAS training will include all training materials required to provide complete and comprehensive training on the operations and general care and maintenance of the system.
- 6. At the end of the DCAS training the Owner and staff will be proficient in the operations and general care and maintenance of the system. The Owner will determine that the factory training has met the needs of the owner

and if the training fails to meet the owner's needs, additional training will be provided at no additional cost to the owner.

2.16 System Acceptance

- A. Final acceptance testing of the Work will be conducted by the Security Consultant and the owner.
- B. Before system acceptance testing by the Security Consultant can commence, The Security Contractor shall conduct a complete in-house QA/QC test of the entire Intrusion detection security system and provide the Security Consultant with a written report on the results of that test. During the QC/QA test the Security Contractor shall place the DCAS in service mode and calibrate and test all equipment.
- C. Following completion of the initial testing and correction of any noted deficiencies, the Security Contractor shall conduct a two-day burn-in test. The intent of the burn-in test shall be to demonstrate that the DCAS is operational by placing it in near real operating conditions. During this period the DCAS shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. The Security Contractor shall record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.
- D. The Security Contractor shall deliver to the Security Consultant a detailed report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Security Consultant that the installed DCAS has been calibrated, tested, and is fully functional as specified herein.
- E. Prior to any final acceptance testing, the Security Contractor shall submit two sets of preliminary (draft) Record Drawings to the Security Consultant. The preliminary Record Drawings are to be used by the Security Consultant to conduct the system final test.
- F. Prior to the final acceptance test, the Security Contractor shall coordinate with Owner and Security Consultant for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Security Contractor's and its Subcontractors' tools, construction equipment, machinery and all surplus materials.
- G. Upon written notification from the Security Contractor that the Security System is completely installed, integrated and operational, and the burn-in testing completed, the Security Consultant and owner will conduct a final acceptance test of the entire system.
- H. During the final acceptance test by the Security Consultant and Owner the Security Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. All physical and functional requirements of the project shall be demonstrated and shown. This demonstration will begin by comparing "as built" conditions of the Security System to requirements outlined in the Specification, item by item. Following the Specification compliance review, all Security System head-end equipment will be evaluated.
- I. The functionality of the various interfaces between systems will be tested.
- J. Following the Security System head-end equipment and console review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.
- K. All equipment shall be on and fully operational during all testing procedures. Provide all personnel, equipment, and supplies necessary to perform all site testing. The Security Contractor shall provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the other will be required to demonstrate the function of each device. The Security Contractor shall supply at least two two-way radios for use during the test. A manufacturer's representative may be present on site to answer any questions that may be beyond the technical capability of the Security Contractor's employees, if the Security Contractor so elects or by specific request of the Security Consultant or Owner, at no charge to the Security Consultant or Owner.
- L. Upon successful completion of the final acceptance test (or subsequent punch list retest) the Security Consultant will issue a letter of final acceptance.
- M. The Security Contractor should be aware that the Security Consultant retains the right to suspend and/or terminate testing any time when the system fails to perform as specified. If it becomes necessary to suspend the test, all the Security Consultant fees and expenses related to the suspended test will be deducted from the Security Contractor's

retainage. Furthermore, in the event it becomes necessary to suspend the test, the Security Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Drawings. The Security Contractor shall supply the Security Consultant with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest. During the final acceptance test, no adjustments, repairs or modifications to the system will be conducted without the permission of the Security Consultant.

2.17 Project Closeout Documentation

- A. Owner/Maintenance manuals and related supplies
 - 1. The Security Contractor shall provide the owner with three (2) sets of Operations/maintenance manuals.
 - 2. The Security Contractor shall provide the owner with three (3) sets of keys to all the security enclosures. Each Key set and enclosure shall be clearly identified by number and location.
 - The Security Contractor shall provide the owner with any materials required to operate and maintain the DCAS.

B. As-Built Drawings

- 1. Drawings shall be provided to the Security Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Security Consultant.
- 2. Three (3) sets of drawings depicting the condition of the intrusion detection system as installed.
- As-Built drawings shall be produced in AutoCAD 2010 or higher and provided in hardcopy and electronically in .dwg and PDF format.
- 4. Hardcopy drawings shall be provided in the original size as issued by the Security Consultant.
- Drawings shall retain the formatting and title block of the original drawings as issued by the Security Consultant.
- 6. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, pathways, alarm device locations and labeling scheme.

2.18 Spare Parts

- A. Security Contractor to provide spare parts as indicated below:
 - 1. (1) DCAS Control panel and Keypad
- B. The cost for these spare parts shall be included in the cost of project/proposal. Spare parts are to be turned over to the Owner for storage.

2.19 Contactor's Statement of Warranty

- A. Statement of warranty shall be provided to the Security Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Engineer.
- B. The Security Contractor shall furnish a minimum of a one (1) year warranty of the system on all materials, labor and workmanship starting at final system acceptance by the Owner and Security Consultant.
 - The Security Contractor will be responsible to respond to warranty issues within no more than four (4) hours, and if the warranty condition is deemed to be an emergency by the owner the Security Contractor will be responsible to respond to emergency warranty issues within no more than one (1) hour from the time of notification. All warranty calls will have no cost to the owner.

- 2.20 One original and two copies of Security Contractor's SERVICE AND WARRRTY terms and conditions to include contact information (i.e. Security Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.
- 2.21 The Security Contractor shall provide as part of the base bid and any future change orders itemized listing of all labor, equipment and material required to meet the specifications for this section of work. This listing shall include Part Number, Description, Unit of Measure, Unit Cost, Quantity, Labor Cost, and Extended Cost and any taxes.

Part Number	Description	Unit of Measure	Unit Cost	Quantity	Labor Cost	Extended Cost
Total Equipment a	\$					
Total Labor and Installation					\$	
Grand Total	\$					

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SECTION 28 2300

VIDEO SURVEILLANCE SYSTEM

PART 1- GENERAL

- 1.0 This section identifies the requirements, technical design, and specifications for the electronic video surveillance system for the Texas Department of Parks and Wildlife-Tyler State Park located in Tyler, Texas ("Owner"). The electronic surveillance system as specified is an industry-standard and includes and includes interior and exterior surveillance cameras, mounts, surge protector, software, and licenses as specified.
- 1.1 In the execution of this work, the Contractor shall comply in every way with the requirements of local laws and ordinances, the laws of the State of Texas, the National Board of Fire Underwriters, OSHA, accepted industry standards and the National Electrical Code. If, in the opinion of the Contractor, there is anything in the specifications that will not strictly comply with the above laws, ordinances, and codes, the matter shall be referred to Architect for a decision before proceeding with that part of the work.
- 1.2 Contractor shall include materials, equipment, and labor necessary to provide a complete and functional access control system regardless of any items not listed or described in this specification or associated drawings.
- 1.3 The Contractor shall be a certified distribution and integration partner of the proposed system(s) prior to submitting a proposal for this work. Contractor shall submit a clear and legible copy of the company's certificates and applicable licensing within the proposal response. Failure to include this information may result in DISQUALIFICATION of the Vendor's response documents.

1.4 Requirements

- 1. Contractor Experience Requirements
- 2. Submittal Requirements
- 3. Acceptable Manufacturers
- 4. Codes, Standards and Regulations
- 5. General Requirements
- 6. System Requirements
- 7. Testing Requirements
- 8. Training Requirements
- 9. Project Closeout Documentation
- 10. Attachments

1.5 Related Requirements

1. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 28 23 00 and shall be complied with in every respect. The Contractor shall examine all the items which make up the Contract Documents and shall coordinate them with the work on the project.

1.6 Contractor Experience Requirements

- 1. The Contractor shall possess all relevant Manufacturer Certifications (i.e. hardware installation, software installation and programming, etc.) for both the company and individual technicians prior to submitting a bid for the work.
- 2. The Contractor shall have been in business for a minimum of five (5) years.
- 3. The Contractor shall have a local office with local technicians and an adequate workforce to complete this project within a 75-mile radius of the project site.
- 4. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.
- 5. The security Contractor and any subcontractors involved in the installation of the system shall maintain a State of Texas, Department of Public Safety private security license for the sales/installation and service of security system for the full duration of the project. Each employee of the company shall maintain a State of Texas, Department of Public Safety private security license duration of the project. The owner may at any time during the installation ask to see a copy of the company's and/or individual employees the State of Texas, Department of Public Safety private security licenses.
- 6. Subcontractors shall be identified at the time of bid and comply with the requirements and intentions of these specifications, associated drawings, and related contract documents.

1.7 Submittal Requirements

- 1. Pre-Installation Submittal
 - Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Security Consultant.
 - 2. Manufacturer product data sheets for each proposed system component.
 - a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted.
 - 3. Shop drawings of the proposed system installation.
 - a. Shop drawings shall include surveillance camera locations, rack elevations, installation typical details, preliminary cable numbers, proposed cable pathways, system schematics, and riser diagrams. Shop drawings shall be submitted on 30" X 42" bond paper.
 - b. The Security Contractor shall maintain a set of shop drawings on site at all time and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Security Consultant/Owner.
 - 4. Itemized list of all equipment, materials and labor required for the installation of the electronic surveillance system as specified herein.
 - a. This list shall be provided in printed and electronic format (Microsoft Excel) and shall contain: Part Number, Description, Unit of Measure, Unit Cost, Quantity, Labor Cost and Extended Cost to provide a complete and functional electronic surveillance system.
 - Manufacturer Product Certifications for Company.
 - Manufacturer Product Certifications for Installers.
 - 7. Manufacturer Warranty letter.

- 8. Documentation indicating that Contractor has been in business for (5) years.
- 9. Address of Contractor's local office within a 75-mile radius of the project site.
- 10. Quantity of full-time local technicians within a 75-mile radius of the project site.
- 11. List of five (5) contractor-installed projects of a similar size and scope in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
- 12. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.

PART 2- PRODUCTS

2.1 General Requirements

- 1. The following sections specifically list the acceptable equipment types and items for this project.
- 2. The Security Consultant will have final determination of acceptability of all proposed equipment and must
- 3. Proposed equivalent items must be approved in writing by the Security Consultant prior to submitting a bid. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.
- 4. In the event a manufacturer's specified product or part number has changed or is no longer available, the Security Contractor shall substitute the appropriate equivalent manufacturer's part number.
- 5. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished.
- 6. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.
- 7. All wiring, equipment, and installation materials shall be new and of the highest quality.
- 8. Labels on all wiring, materials, and equipment must indicate a nationally recognized testing laboratory.
- 9. Original Equipment Manufacturer (OEM) documentation must be provided to the Security Consultant which certifies performance characteristics and compliance with industry standards.

2.2 Acceptable Manufacturers

- 1. Electronic Surveillance System Software/Hardware
 - 1. AXIS
 - 2. Bosch
 - 3. Hanwha
 - 4. Panasonic
 - 5. Salient Systems
 - 6. Exacq Technologies

- 2. Electronic Surveillance Management Software & System Server and Storage. VMS shall provide Min. requirement is 45 days of recorded video storage, at 24 FPS, 50% motion video
 - Salient Systems Power Pro includes: Intel Xeon CPU; 16GB RAM; Windows 10 IOT 64 Bit; Warranty:3 year Basic: Keyboard & mouse included, Shared OS Drive rev:007. Part number PS540T3B
 - 2. Salient Systems CV 20/20 Pro I IP camera license- CompleteView PRO. Part number 10 SPPI
 - 3. Or approved equal
- 3. Surveillance Cameras
 - 4. Interior & Exterior IP Cameras
 - a. AXIS M3046-V 2.4 mm Part Number: 0806-001
 - b. AXIS P3227-LVE Part Number: 0886-001
 - c. AXIS P3807-PVE Part Number: 01048-001
 - d. AXIS Q1700-LE Part Number: 01782-001
 - e. Or approved equal
 - 5. Interior & Exterior Cameras Accessories
 - a. AXIS T8061 Ethernet Surge Protector Part Number: 5801-641
 - b. AXIS T91B47 Pole Mount 100-410 mm Part Number: 01164-001
 - c. AXIS T91B67 Pole Mount 65-165 mm Part Number: 5504-821
 - d. AXIS T91E61 Wall Mount Part Number: 5506-481
 - e. AXIS T94B05L Recessed Mount Part Number: 01150-001
 - f. AXIS T94K01D Pendant Kit Part Number: 5505-081
 - g. AXIS T94V01L Recessed Mount Part Number: 5801-441
 - h. AXIS T94V02D Pendant Kit Part Number: 01505-001
 - i. Or approved equal
- 3. Power Equipment
 - 1. Powered Fiber for cameras C-E-06, C-E-07 and C-E-08 (Special Note: CommScope Power Fiber installation will be provided and performed by a factory trained and certified technical company)
 - a. CommScope POE Extender 60 W 2 port-PoE Extender, Universal Mount, Outdoor, 60 Watt, 2-Port. Part number PFU-P-C-O-060-02
 - b. CommScope PCOSP-6S-BK-10FT- CAT6, F/UTP, Outdoor Rated Patch Cord. Part number CO11152-01F010
 - c. CommScope SFC-LCF-09-8Y-12-PACK- Qwik-Fuse Connector, LC, SM-UPC, Blue, for 250µm/900µm, 12 per pack. Part number: 760243372

- d. CommScope Powered Fiber Cable, OS2, 2 Fibers, Outdoor, 16AWG Conductor. Part number PFC-S02O16F
- e. Finisar 1000BASE-LX SFP 1000BASE-LX and 1G Fiber Channel (1GFC) 10km Industrial Temperature Gen 3 SFP Optical Transceiver. Part number FTLF1318P3BTL
- f. Anaconda M20x1.5 to 1/2" Sealtite Adapter. Part number 7120201
- g. CommScope Standard Density 1U sliding Panel, accepts (3) LGX/1000 style splice cassettes, modules or panels, providing up to 36 duplex LC ports. Part number 760231449
- h. CommScope TeraSPEED® Splicing cassette, 24LC, 900µm. Part number 760236501
- i. CommScope TeraSPEED® OS2 LC to LC, Fiber Patch Cord, 1.6 mm Duplex, Riser, yellow jacket, 6 ft. Part number FEWLCLC42
- j. Finisar 1000BASE-LX and 1G Fiber Channel (1GFC) 10km Industrial Temperature Gen 3 SFP Optical Transceiver. Part number FTLF1318P3BTL
- k. CommScope Power Express Starter Shelf Kit (Shelf and Alarm Module) Part number PFP-PX-S1
- I. CommScope Power Express 8 port Module. Part number PFP-PX-8M
- m. CommScope Power Express Slot Filler. Part number PFP-PX-SF
- n. CommScope Rectifier Shelf. Part number PFP-SPS-S1
- o. CommScope Rectifier Controller with Display. Part number PFP-SPS-C1
- p. CommScope Rectifier Module. Part number PFP-SPS-1600M
- q. CommScope Rectifier Slot Filler. Part number PFP-SPS-SF
- r. Or approved equal
- 2. If the customer Network Switch is not capable of accepting the SFP in the IDF, then a media converter will be needed for each device.
 - a. Transition Networks 19-Slot Chassis for the ION Platform AC Powered. Part number ION219-A
 - b. Transition Networks ION Gigabit Ethernet Media and Rate Converter Module 10/100/1000Base-T to 1000Base-SX/LX. Part number C3210-1040
 - c. Or approved equal
- 3. Surge Protection (where required)
 - a. Ditek DKT-RM12POE 12-Channel
 - b. Ditek DTK-PVTIP
 - c. Or approved equal
- 4. Labeling
 - 1. Permanent Labels for Fiber Optic Cables
 - a. Panduit Self-Laminating Labels

- b. Brady
- 5. Fire Stop
 - 1. STI Spec Seal
 - 2. 3M Products

2.3 Cameras

- 1. Camera type, location, enclosure and mounting requirements shall be as indicated on the drawings.
- 2. All exterior/interior cameras are to be mounted as indicated on drawings.
- 3. Connect to data cable provided by other as indicated on technology and security drawings.
- 4. Camera will receive power via Ethernet from existing POE Switch, unless noted otherwise.
- 5. Provide surge suppressor for all exterior mounted cameras.
- 6. Surge suppression shall be configured to protect video, power, and data wiring for exterior cameras.
- 7. All cameras shall be secured to solid structure; cameras mounted in ceiling tile will be secured to solid structure above.
- 8. Provide camera housings and mounts as indicated.
- 9. Coordinate with Owner camera port assignments.

2.4 Spare Parts

- 1. Provide the following spare parts.
 - 1. One (1) interior camera and mount.
 - 2. One (1) exterior camera and mount.
- 2. The cost for these spare parts shall be included in the cost of each school. Spare parts are to be turned over to the District for storage and will be used for immediate repair. Labor to install will be covered under warranty and maintenance scope of work.
- 2.5 Basis of Design for Server and Storage
 - 1. Program all cameras initially to provide for recording and live viewing, 8 FPS, H.264 compression, 4 CIF, 50% motion to be archived locally for minimum of 45 days.
 - 2. The Security Contractor will coordinate with the Server and VMS manufacturer to assure that the recording requirements for the video storage are provided.
 - As part of the Security Contractors submittal package, the Contractor shall provide the storage calculation work-sheets showing how the Contractor reached the sizing for the video storage requirements. A letter from the Server and VMS manufacturer verifying the storage will also be required before the Contractor will be released to purchase the video storage server.
 - 2. If the Contractor does not meet the minimum video storage requirement, the Contractor will be fully responsible for any additional costs of materials and labor to meet these requirements.

2.6 Network Communications

PoE network switches to be Owner-Provided and Owner-Installed.

2. Category 6 structured cable system to be provided from the camera to the owner provided switch in the IDF/MDF as noted on the plans.

PART 3- EXECUTION

- 3.1 Codes, Standards, Regulations
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
 - 2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
 - 4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials
 - 3. Alliance for Telecommunications Industry Solutions (ATIS)
 - 4. Building Industry Consulting Service International (BICSI)
 - 1. Telecommunications Distribution Methods Manual 13th Edition
 - 2. Outside Plant Design Reference Manual 5th Edition
 - 3. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
 - 4. NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling
 - 5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - 5. Electronics Industry Alliance (EIA)
 - 6. Federal Communications Commission (FCC)
 - 1. FCC Part 15, Radiated Emissions Limits, revised 1998
 - 2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
 - 3. FCC Part 76, Cable Television Service, revised 1998
 - 7. Insulated Cable Engineers Association (ICEA)
 - 1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
 - ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
 - 3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors
 - 8. International Electrotechnical Commission (IEC)
 - 9. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

- 1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System
- 2. IEEE Standard 1100-1999 Recommended for practice for Powering and Grounding Sensitive
- 3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
- 4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
- 5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms
- 10. International Organization for Standardization (ISO)
 - 1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
 - 2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
 - 3. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
 - 4. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
 - 5. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
- 11. National Cable Television Association (NCTA)
- 12. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits
- 13. National Fire Protection Association (NFPA)
 - 1. NFPA-70, National Electrical Code
 - 2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
 - 3. NFPA-101, Life Safety Code
 - 4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
 - 5. NFPA-780, Standard for the Installation of Lightning Protection Systems.
- National Institute Standards and Technology (NIST)
- 15. Occupational Safety and Health Administration (OSHA)
- 16. Telecommunications Industry Association (TIA)
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, 2009
 - ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009
 - 3. ANSI/TIA -568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, 2009
 - 4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, 2008
 - 5. ANSI/TIA/EIA–569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, 2005

- 6. ANSI/TIA-569-B Amendment 1, Commercial Building Standard for Telecommunications Pathways and Spaces, 2009
- 7. ANSI/TIA/EIA-606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2012
- 8. ANSI/TIA/EIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications, 2011
- 9. ANSI/TIA-758, Customer-Owned Outside Plant Telecommunications Infrastructure Standard, 2004
- 17. Underwriters Laboratories, Inc. (UL)
 - 1. UL 510 (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
 - 2. UL 910 (NFPA 262 1990) Applicable Flame Test
- In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify the Security Consultant in writing of any such occurrences before purchasing or installing any equipment or materials. The Security Consultant will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications.

3.3 General Requirements

- Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the laws, ordinances, and rules, the matter shall be referred to the Security Consultant for direction before proceeding with that part of the work.
- 2. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines.
- 3. No deviations from the plans or specifications shall be made without full consent in writing of the Security Consultant. The Contractor shall have written approval from the Security Consultant for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain written approval from the Security Consultant prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- 4. The Contractor shall obtain written permission from the Security Consultant before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.
- 5. Contractor shall notify the Security Consultant a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Security Consultant to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- 6. The Contractor shall maintain a work area free of debris, trash, empty wire reels, scrap wire, etc., and dispose of such items daily and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- 7. Equipment and materials installed by the Contractor shall be free of defects and damage.
- 8. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.

- Contractor shall notify the Security Consultant and Owner of any damage to the property caused by the contractor within 4 hours of the event and be responsible for the repair of any damage caused by the contractor during the installation.
- 10. Contractor shall test all wires prior to installation. By failing to perform this testing operation, the Contractor shall accept the wire as compliant and assume all liability for the replacement of the wire at no cost to the Owner should it be found defective later.
- 11. Contractor shall maintain a set of working specifications, design drawings, and shop drawings to be always kept on site and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Security Consultant.
- 12. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.
- 13. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.
- 14. Contractor shall make all stored equipment and materials available for inspection at the request of the Security Consultant.
- 15. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.
- 16. Wires shall be properly supported in accordance with industry standards at all times. Improperly supported wires shall be corrected by the Contractor at no cost to the Owner.
- 17. Contractor shall be responsible to properly protect wiring from damage by other trades during construction.
- 18. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
- 19. The Contractor shall not install wires in conduits or sleeves without nylon bushings. Wires installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
- 20. The Contractor shall provide any lifts necessary to perform work.

3.4 System Requirements

- 1. Quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a complete and functioning system. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity shall be furnished.
- 2. Electronic Surveillance System Software/Hardware
 - 1. Electronic Surveillance Management System
 - a. Existing Video Insight (Owner Provided / Owner Installed)
 - 2. Electronic Surveillance System Licensing
 - The Contractor shall furnish and install.
 - 1) One (1) each camera license for each camera as required per Manufacturer. (as may be required)

 The Contractor shall provide installation in accordance with Manufacturer's installation instructions.

Surveillance Cameras

- a. Interior Camera
 - 1) Fixed Dome IP Camera
 - 2) The Contractor shall furnish and install the following as indicated on the technology drawings and associated equipment schedules and diagrams.
 - 3) The Contractor shall provide installation in accordance with Manufacturer's installation instructions.
 - 4) The Contractor shall coordinate exact camera location prior to installation.
 - 5) The Contractor shall energize and commission equipment in accordance with manufacturer's instructions and guidelines.
 - 6) The Contractor shall program all network address information for the camera and ensure the camera can communicate with the electronic surveillance system server.
 - 7) Coordinate with Owner camera port assignments.

b. Exterior Camera

- 1) Fixed Dome IP Camera
- 2) The Contractor shall furnish and install the following as indicated on the technology drawings and associated equipment schedules and diagrams.
- 3) The Contractor shall provide installation in accordance with Manufacturer's installation instructions.
- 4) The Contractor shall coordinate exact camera location prior to installation.
- 5) The Contractor shall energize and commission equipment in accordance with manufacturer's instructions and guidelines.
- 6) The Contractor shall program all network address information for the camera and ensure the camera can communicate with the electronic surveillance system server.
- 4. Power Equipment All Cameras are PoE from Owner provided switches
- 5. Exterior ESS Camera Surge Protection
 - a. Provide surge suppressor for all exterior mounted cameras.
 - b. Surge suppression shall be configured to protect video, power and data wiring for exterior cameras.
- 6. Electronic Surveillance System Cabling
 - a. Provided under Division 27 1000 (provide from the camera to the owner provide switch by the security contractor)
- 7. Pathway Cable Support

- a. Communication room equipment racks/cabinets and Category 6 structured cable system are to be provided by others and this section is for information only.
- b. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
- c. When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Contractor furnished and installed j-hooks or saddle straps.
- d. No cable pathway shall exceed 40% fill ratio.
- e. The contractor shall furnish a separate j-hook or saddle strap pathway for each wire type.
- f. J-hooks and saddle straps shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.
- g. J-hooks shall be furnished with closure clips.
- h. Maximum sag between supports shall not exceed twelve-inches (12").
- i. Contractor shall establish j-hook and saddle strap pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.

8. Cable Dressing

- a. No nylon cable ties shall be used at any time during the installation of the wire.
 - 1) Above Ceiling
 - a) Contractor shall furnish and install plenum-rated hook & loop straps in plenum-rated airspaces.
 - b) The Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
 - 2) Equipment Rooms / Telecommunications Rooms
 - a) The Contractor shall bundle all visible wires with Contractor furnished and installed hook & loop straps.
 - b) Hook & loop straps shall be installed twenty-four (24) inches apart on center.

9. Grounding and Bonding

- a. General
 - 1) The Contractor shall ensure metal-to-metal contact for all terminations.
 - 2) All materials shall be UL Listed.
 - 3) All connections shall be made with UL Listed compression 2-hole lugs.
 - 4) Contractor shall use an anti-oxidation compound on all connections.
 - 5) In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.

- A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every 3rd floor in between).
- 7) The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.

10. System Labeling

- a. Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.
- b. Cables shall be labeled within (3) inches from the termination point inside the Equipment Room/Telecommunications Rooms.
- c. Cables shall be labeled within (3) inches from the termination point at the device end.
- d. Cables shall be labeled identically at both ends.
 - 1) Equipment Room/Telecommunications Rooms
 - a) Contractor shall use the following room designations for wire labeling:
 - (1) MDF/IDF
 - 2) Cable
 - a) Electronic Surveillance System Cable
 - (1) Electronic Surveillance System cable labels shall contain the device number as indicated in the technology drawings, wire origin room number, wire destination room number, and wire type (i.e. C01/122-210/CAT6). In instances where no origin room number exists, utilize the device number as indicated in the technology drawings, wire destination room number, and wire type (i.e. C01/210/CAT6).
 - 3) Equipment
 - a) Electronic Surveillance System Devices
 - (1) Equipment to be labeled shall include but not be limited to cameras, network video recorders, video encoders, and media converters. Coordinate name, font style, and devices to be labeled with Owner or Owner's representative before labeling. Provide computer generated labels, handwritten labels will not be accepted.

3.5 Testing Requirements

- 1. Electronic Surveillance System
 - The Contractor shall test and commission each component per the specifications and manufacture's installation instructions.
 - 2. Coordinate final network (ports, IP addresses, programming, etc.) requirements with Architect and Owner.
 - 3. Test the Electronic Surveillance System devices, communication, and programming to ensure system components are functioning as intended.

- 4. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the testing will result in a delay of final testing and acceptance.
- 5. In the absence of a test by the manufacturer, use the operator's manual and demonstrates the ability to complete each of the functions listed.
- 6. Coordinate with the Owner to resolve any programming and communication problems that occurred during the test.
- 7. The Security Consultant will prepare a punch list of items identified during the test that require correction before final acceptance.
- 8. Upon completion of testing and coordination, the Owner and the Security Consultant will conduct a final acceptance test.
- 9. The Contractor shall notify the Security Consultant a minimum of five (5) days in advance to observe field testing.

3.6 Training Requirements

- 1. Electronic Surveillance System
 - Coordinate with the Owner to establish a formal training outline and schedule. Submit a
 comprehensive training curriculum to the Owner once all preliminary coordination is complete. The
 Owner will revise and comment on the curriculum as required.
 - 2. Provide a minimum of 4 hours of operator training, and 4 hours of administrative training, either on or off site on a complete and fully operational system parallel and equal to the system being provided, to representatives of the Owner.
 - a. Operator training shall include, but not be limited to the following:
 - 1) GUI operation
 - 2) Manual and automatic camera call-up procedures
 - 3) Video motion detection functionality
 - 4) Electronic Surveillance System recording playback functionality
 - b. Administrator training shall include, but not be limited to the following:
 - 1) GUI operation and configuration variables
 - 2) Manual and automatic camera call-up procedures (including macro sequence assignment)
 - 3) Video motion detection setup, configuration variables, and functionality
 - 4) Recoding setup, configuration variables, and functionality
 - 5) Electronic Surveillance System recording playback/export functionality
 - 3. Record, label, and catalog all training on DVD. Provide the DVD to the Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for recording all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.

4. The Contractor shall be on call during the Warranty to answer any questions the Owner might have. The Owner reserves the right to use any excess training hours, not used by the time of system completion, for future training as requested by the Owner until the total number of training hours has been completed.

3.7 Project Closeout Documentation

1. As-Built Drawings

- Drawings shall be provided to the Security Consultant at the time of substantial completion. Final
 payment will not be recommended until drawings are received and approved by the Security
 Consultant.
- 2. Three (3) sets of drawings depicting the condition of the electronic surveillance system as installed.
- 3. As-Built drawings shall be produced in AutoCAD 2010 or higher and provided in hardcopy and electronically in .dwg and PDF format.
- 4. Hardcopy drawings shall be provided in the original size as issued by the Security Consultant.
- 5. Drawings shall retain the formatting and title block of the original drawings as issued by the Security Consultant.
- 6. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, pathways, camera locations and labeling scheme.

2. Test Documentation

- Test documentation shall be provided to the Security Consultant at the time of substantial completion.
 Final payment will not be recommended until these test results are received and approved by the Security Consultant.
- 2. Three (3) sets of test documentation for the electronic surveillance system as installed.
- 3. Test results shall be provided in hard copy and electronic format (i.e., manufacturer's proprietary testing software along with Contractor's test records).
- 4. Test documentation shall be bound, sectioned, and tabbed in the following sequence as applicable:
 - 1) Electronic Surveillance System
 - 2) Electronic Surveillance System Wiring

3. Contactor's Statement of Warranty

- 1. Statement of warranty shall be provided to the Security Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Security Consultant.
- 2. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
- 3. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e. Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

The contractor shall provide an itemized listing of all labor, equipment and material required to meet the specifications for this section of work. This listing shall include Part Number, Description, Unit of Measure, Unit Cost, Quantity, Labor Cost, and Extended Cost and any taxes.

Part Number	Description	Unit of Measure	Unit Cost	Quantity	Labor Cost	Extended Cost
Total Equipment a	nd Materials				\$	
Total Labor and In	stallation				\$	
Grand Total					\$	

END OF SECTION 28 2300

SECTION 28 3100

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes design and installation of a complete fire detection and alarm system, including fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.
- B. Fire alarm system shall include:
 - Main Building (New Headquarters Building): Main fire alarm control panel (FACP) with remote annunciator panel (ANN).
 - 2. New Fee Booth: Fire alarm annunciation devices.
 - 3. Main Building FACP shall provide communication for continuous monitoring by remote monitoring service.
- C. Related Sections:
 - 1. Section 08 71 00 Door Hardware: Door closers, electric locks, electric releases.
 - 2. Section 23 33 00 Air Duct Accessories: Smoke dampers.
 - 3. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - 4. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 5. Section 26 05 33 Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

- A. National Fire Protection Association; current adopted edition:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 72 National Fire Alarm and Signaling Code.
 - 3. NFPA 101 Life Safety Code.
 - 4. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- B. International Code Council; current adopted edition:
 - 1. International Building Code.
 - International Fire Code.
- C. Americans with Disabilities Act (ADA) Standards for Accessible Design; current adopted edition.

1.03 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.
- E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.04 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

- B. Project Record Documents: Record actual locations of fire alarm equipment.
- Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.05 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
- B. Perform Work in accordance with Authority having jurisdiction.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
- B. Installer: Certified fire alarm installer with service facilities within 100 miles of Project.
- C. Designer: Design fire alarm under direct supervision of NICET Level III or IV certified fire alarm technician or registered fire protection engineer licensed in the State of Texas, employed by system installer or fire alarm control panel manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect equipment from damage, corrosion, and contamination from debris.
- C. Store electronic equipment and components in a dry location, protected from weather and temperature extremes.
- Protect equipment by transporting and storing in factory provided boxes and containers.

1.08 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 33.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.09 MAINTENANCE SERVICE

- A. Section 01 70 00 Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish six keys of each type.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish five of each type of smoke detector and heat detector.

C. Furnish five of each type of notification appliance.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Fire Alarm System: Non-coded, UL-certified, addressable system with multiplexed signal transmission and horn/strobe evacuation annunciation; NFPA 72 compliant; with manual and automatic activation.
- B. Source Limitations:
 - 1. Components: Compatible with, and operate as, a single system; and listed for use with the selected system
 - 2. Electrical Components and Devices: Products of a single manufacturer.
 - 3. 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 ACCEPTABLE MANUFACTURERS

- A. Products of the following manufacturers will be considered acceptable, where they are shown to meet the basis of design, provide the coverages and functionality required by the Drawings and specifications, and are supported by qualified designers and installers:
 - 1. ADT.
 - 2. EST (Edwards); UTC Climate, Controls & Security.
 - 3. Fire-Lite Alarms, Inc.; Honeywell International.
 - 4. Gamewell-FCI; Honeywell International.
 - 5. Notifier; Honeywell International.
 - Siemens.
 - 7. SilentKnight; Honeywell International.
 - 8. Simplex; Tyco SimplexGrinnell.

2.03 ALARM SEQUENCY OF OPERATION

- A. Fire alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Smoke, heat, and flame detectors.
 - 3. Duct smoke detectors.
- B. Fire alarm signal shall initiate the following:
 - 1. Continuously operate alarm notification appliances.
 - Identify specific device initiating the event at Fire Alarm Control Panel and remote annunciators.
 - 3. Display system status on graphic annunciator.
 - 4. Record the event to system memory.
 - 5. Transmit an alarm signal to the remote alarm receiving station.
 - 6. Unlock electric door locks in designated egress paths.
 - 7. Release fire and smoke doors held open by magnetic door holders.
 - 8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 - 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
- C. Supervisory signal initiation shall be by one or more of the following devices and systems:
 - User disabling of zones or individual devices.
- D. System trouble signal initiation shall be by one or more of the following devices and systems:
 - 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, or remote annunciator.
- 4. Loss of primary power at Fire Alarm Control Panel.
- 5. Ground or a single break in internal circuits of Fire Alarm Control Panel.
- 6. Abnormal AC voltage at Fire Alarm Control Panel.
- 7. Break in standby battery circuitry.
- 8. Failure of battery charging.
- 9. Abnormal position of any switch at Fire Alarm Control Panel or annunciator.
- E. Supervisory signal and system trouble signal shall initiate the following:
 - Initiate notification appliances.
 - Identify specific device initiating the event at Fire Alarm Control Panel and remote annunciators.
 - 3. Display system status on graphic annunciator.
 - 4. Record the event to system memory.
 - 5. After a time-delay of 200 seconds, transmit a supervisory signal or system trouble signal to the remote alarm receiving station.
- F. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.

2.04 FIRE ALARM CONTROL PANEL

- A. Product Description: Modular fire alarm control panel with surface wall-mounted enclosure.
- B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, smoke dampers, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- C. System Supervision: Component or power supply failure places system in trouble mode.
- D. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from initiating alarm.
- E. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.
- F. Remote Station Signal Transmitter: Electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals over ethernet to central station receiver.
- G. Auxiliary Relays: Sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

2.05 MANUAL FIRE ALARM STATIONS

- A. General: Stations shall comply with UL 38, shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box, except where indicated to be surface mounted.
 - 1. Double-action mechanism requiring two actins to initiate alarm, pull-level type; with integral addressable module arranged to communicate status (normal, alarm, or trouble) to Fire Alarm Control Panel.

2. Station Reset: Key- or wrench-operated switch.

2.06 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be four-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at Fire Alarm Control Panel for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by Fire Alarm Control Panel.
 - Rate-of-rise temperature characteristic of combination smoke- and heatdetection units shall be selectable at Fire Alarm Control Panel for 15 or 20 deg F per minute.
 - Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at Fire Alarm Control Panel to operate at 135 or 155 deg F.
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.
- B. Photoelectric Smoke Detectors:
 - Detector address shall be accessible from Fire Alarm Control Panel and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at Fire Alarm Control Panel, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - Detector address shall be accessible from Fire Alarm Control Panel and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at Fire Alarm Control Panel, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

 Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motorcontrol circuit.

2.07 SYSTEM HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Temperature sensors shall test for and communicate the sensitivity range of the device.
- C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.
- D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.

2.08 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal, such as to circuit-breaker shunt trip for power shutdown.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 - Operate notification devices.

2.09 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.
- B. 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.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: 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, using the coded signal prescribed in UL 464 test protocol.

- F. Visible Notification Appliances: 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-high letters on the lens.
 - 1. Rated Light Output: 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.

2.10 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of Fire Alarm Control Panel for alarm, supervisory, and trouble indications. Manual switching functions shall match those of Fire Alarm Control Panel, including acknowledging, silencing, resetting, and testing.
- B. Mounting: Flush cabinet, NEMA 250, Type 1.
- C. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of Fire Alarm Control Panel. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from Fire Alarm Control Panel and automatically transmit a detailed report to a remote central station. The system shall utilize a heart beat signal to test for communications availability at an interval not exceeding 90 seconds. If communication is unavailable for longer than 200 seconds, transmitter shall initiate a local trouble signal. Transmitter shall report communications service restoration to the central station.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that ethernet connection is available.
 - 2. Programming device.
 - LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or Fire Alarm Control Panel.
- D. 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-initiating device.
 - 4. Loss of ac supply.
 - Loss of power.
 - 6. Low battery.
 - 7. Abnormal test signal.
 - 8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 WIRE AND CABLE

- A. Product Description: Non-power limited fire-protective signaling cable, copper conductor; 150-volt insulation rated 60 degrees C.
- B. Cable Located Exposed in Plenums: Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.
- C. Fire alarm circuit conductors have insulation color or code as required by NFPA.

2.13 INSTRUCTION CHARTS

- A. Printed instruction charts, detailing to operators the steps that should be taken when a signal (normal, alarm, supervisory, or trouble) is received and when the operator desires to perform a test or drill.
 - 1. Locate for easy access from Fire Alarm Control Panel, Remote Annunciator, and any other location where operations are to be performed.
 - 2. Frame and secure to wall at location directed by Owner. Frame: Stainless steel or aluminum with polycarbonate cover.
 - 3. Provide one additional copy with each copy of operation and maintenance data submittal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas for compliance with environmental conditions affecting performance of the Work. Verify that manufacturer's recommended 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.

3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, 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. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire Alarm Stations:
 - 1. Install stations in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount stations on a background of a contrasting color.
 - 3. The operable part of stations shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
 - 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. Smooth ceiling spacing shall not exceed 30 feet.
- Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72
- 5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
- 6. 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.
- 7. In lay-in grid ceilings, locate detectors centered in ceiling tile.
- E. 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.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
 - Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

3.03 PATHWAYS

- A. Fire alarm system cabling shall be installed in conduit, except that open wiring may be installed in the following locations:
 - 1. Above lay-in ceilings and accessible ceilings.
 - 2. Above gypboard ceilings, where cables are located within 36 inches of an access panel.
 - 3. In mechanical rooms where installed at least 108 inches above finished floor.
- B. Except where open wiring methods are specifically allowed above, fire alarm cables shall be installed in raceway systems in accordance with Section 26 0533, "Raceways and Boxes for Electrical Systems".
 - Exposed raceways shall be primed and painted.
- C. Where open wiring methods are used for routing cabling, fire alarm cables shall be:
 - 1. Listed and labeled for installation in plenum spaces.
 - 2. Supported in j-hook supports at 60 inches on center, or in a cable tray system.

3.04 CONNECTIONS

- A. For fire protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 "Door Hardware" specification. Connect hardware and devices to fire alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Electronically locked doors and access gates.

3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from Fire Alarm Control Panel.

3.06 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.

3.07 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - Visual Inspection: Conduct visual inspection prior to testing.
 - a. 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.
 - Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. 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.
 - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals"

chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

- 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. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.09 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION 28 3100

SECTION 31 0000

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including Soils Report, and Owner's General Conditions and Special Conditions, apply to this Section.
- B. Geotechnical Report: Perform earthwork complying with the requirements of Geotechnical Report for the site.
- C. Reference Specification for earthwork and related products shall be the "Texas Standard Specifications", latest edition as published by Texas Department of Transportation (TxDOT).
- D. Per Landscape Architect, only backfill landscape area to a point 0.4 feet or 5 inches below the proposed finish grade. Refer to Landscape Plans and Specifications for further instructions.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing of subgrade for walks and pavements.
 - 2. Excavating and backfilling for site utilities.
 - 3. Preparing the ground surface and cut/fill activities.
- B. Excavating and Backfilling for Mechanical/Electrical Work: Refer to Divisions 23 and 26 sections for excavation and backfill required in conjunction with underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
- C. Excavation, backfilling, preparation and conditioning of areas within building lines shall be in conformance with Structural plans and specifications.

1.3 DEFINITIONS

- A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
- B. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.
- C. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

1.4 SUBMITTALS

- A. Test Reports: Submit the following reports directly to Architect and Owner from the testing services:
 - 1. Test reports on borrow material.
 - 2. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - 3. Field reports; in-place soil density tests.
 - 4. One optimum moisture-maximum density curve for each type of soil encountered.
 - 5. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: Contractor shall employ and pay for a qualified independent geotechnical testing laboratory to perform soil testing and inspection service during earthwork operations, unless otherwise provided by the Owner.

C. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct required field and laboratory geo-technical testing without delaying the progress of the Work.

1.6 PROJECT CONDITIONS

- A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
 - 1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
- B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner, jurisdictional agencies, and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
 - 2. Do not interrupt existing utilities serving facilities.
 - 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with Owner, jurisdictional agencies, and utility companies for shutoff of services if lines are active.
- C. Use of Explosives: Use of explosives is not permitted.
- D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 3. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Refer to the geotechnical report for soil materials satisfactory for use as fill and backfill on the project site.
- B. Subbase and Subgrade Material: Refer to the project geotechnical report.
- C. Bedding material shall match pipe/utility manufacturer's recommendation or authority having jurisdiction's standard details/specifications.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

 Earth Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

3.2 STABILITY OF EXCAVATIONS

- A. General: Comply with requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
 - Contractor shall ensure adjacent structures are not impacted by excavations or construction activities.

3.3 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations at no additional cost to Owner.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.4 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill where directed in accordance with all ordinances and regulations. 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. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill in a legal manner.

3.5 EXCAVATION FOR PAVEMENTS

A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.6 TRENCH EXCAVATION FOR PIPES AND CONDUIT OUTSIDE OF BUILDING LINES

- A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.
- B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of utility cross section or embedment on undisturbed soil. Excavate trenches to allow installation of top of pipe below frost line.

- 3.7 BEDDING MATERIAL FOR PIPES & CONDUITS OUTSIDE OF BUILDING LINES
 - A. Crushed Stone Embedment.
 - Description. The aggregates shall consist of durable particles of crushed stone, free from frozen
 material or injurious amounts of salt, alkali, vegetable matter or other material either free or as
 adherent coating, and its quality shall be reasonably uniform throughout. It shall have a wear
 of not more than 40 percent when tested in accordance with Texas SDHPT Test Method Tex410-A.
 - 2. Test. When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the following table:

Standard Crushed Rock - Aggregate Grade 4	Percent	
Retained on 1 1/2 in. sieve	0%	
Retained on 1 in. sieve	0 to 5%	
Retained on 1/2 in. sieve	40 to 75%	
Retained on No. 4 sieve	90 to 100%	
Retained on No. 8 sieve	95 to 100%	

Fine Crushed Rock - Aggregate Grade 8	Percent
Retained on 1/2 in. sieve	0%
Retained on 3/8 in. sieve	0 to 5%
Retained on No. 4 sieve	35 to 60%
Retained on No. 8 sieve	90 to 100%

Coarse Crushed Rock	Percent
Passing 1 1/2 in. sieve	100%
Retained on 3/4 in. sieve	100%

- B. Granular Material. Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over two inches in diameter, clay and organic matter.
- C. Select Material. Select material shall be in accordance with the project geotechnical report.
- D. Foundations of Manholes & Utility Structures. Unless otherwise noted in the plans or in the standard details of the authority having jurisdiction, rock for manhole or utility structure foundations shall meet the requirements for "Crushed Stone Embedment" except the gradation shall be:

	Percent
Passing 5 in. sieve	100%
Retained on 2 in. sieve	100%

E. Natural Gravel. Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in the requirements for "Crushed Stone Embedment". The material shall be washed and screened and not have by weight more than one percent organic matter, clays or loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstone. The gradation shall be:

	Percent
Passing 1 1/2 in. sieve	100%
Retained on 3/4 in. sieve	100%

F. Sand. Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

3.8 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.9 BACKFILL AND FILL

- A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.
 - 1. Backfill & fill under grassed and paved areas shall conform to the materials specified in Part 2 of this Section and the project geotechnical report.
 - 2. Under piping and conduit and utility structures, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.
 - 3. For areas outside building lines: backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
 - a. Concrete is specified in Division 3.
 - b. Do not backfill trenches until tests and inspections have been made. Use care in backfilling to avoid damage or displacement of pipe systems.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation. All dampproofing, waterproofing, and perimeter insulation shall be installed in accordance with the standard specifications.
 - 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
 - 3. Removal of concrete formwork.
 - 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Contractor shall ensure excavations and construction activities do not impact adjacent structures.
 - 5. Removal of trash and debris from excavation.
 - 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.10 PLACEMENT AND COMPACTION

- A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
 - When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- B. Place backfill and fill materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers, unless otherwise defined in the project geotechnical report.
- C. 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. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

- E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Owner/Architect if soil density tests indicate inadequate compaction.
 - 1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D-698:
 - a. Under vehicular pavements, compact lime stabilized subgrade (5% hydrated lime dry unit weight) between 95 percent and 105 percent of the material's maximum dry density at a moisture content between -1% and +3% of optimum moisture unless otherwise stated in the project geotechnical report or plans.
 - b. Compact each layer of backfill or fill material at 95 percent maximum density with a moisture content within 3% of the material's optimum moisture unless otherwise stated in the project geotechnical report or plans.
 - c. Under sidewalks, compact subgrade at 95 percent maximum density with a moisture content within 3% of the material's optimum moisture content unless otherwise stated in the project geotechnical report or plans.
 - Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
 - a. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.11 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
- B. Grading Adjacent to Structures: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
 - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
 - 2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
 - 3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish subgrade surface not more than 1/2 inch above or below required subgrade elevation.
- C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

- A. General: Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course.
 - 1. Refer to other Division 32 sections for paving specifications.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12-inch width of shoulder simultaneous with the compaction and rolling of each layer of subbase course.

- D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
 - 1. When a compacted subbase course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.13 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
 - 1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.
 - a. Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.
 - b. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Owner/Architect.
 - 2. Paved Areas: Perform at least one field density test of subgrade for every 2,000 sq. ft. of paved area. In each compacted fill layer, perform one field density test for every 2,000 sq. ft. of paved area.
 - 3. If based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

3.14 EROSION CONTROL

A. Provide erosion control methods in accordance with Section 31 2500.

3.15 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 0000

SECTION 31 1000

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Soils Report, and Owner's General Conditions and Special Conditions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees.
 - 2. Removal of trees and other vegetation.
 - 3. Topsoil stripping.
 - 4. Clearing and grubbing.
 - 5. Removing above-grade improvements.
 - 6. Removing below-grade improvements.

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
 - 2. Provide protection for roots over 1-1/2 inch diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 - 3. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to Architect. Owner will repair damages to trees and shrubs. Cost to be paid by Contrator.
 - 4. Replace trees which cannot be repaired and restored to full-growth status, as determined by arborist.
- D. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
 - 1. Extent of work on adjacent property is indicated on Drawings.
- E. Salvable Improvements: Carefully remove items indicated to be salvaged, and store on Owner's premises where indicated or directed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Refer to Soils Report for additional requirements. Remove similar items elsewhere on site or premises as specifically indicated. "Removal" includes digging out and off-site disposing of stumps and roots.
 - 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of new construction.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
 - 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 - a. Remove heavy growths of grass from areas before stripping.
 - b. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 - 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.
 - 3. Dispose of unsuitable or excess topsoil same as specified for disposal of waste material.
- C. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing or as directed by local authorities.
 - 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
 - Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings, and is included under work of related Division 23 and 26 sections. Removal of abandoned underground piping or conduit interfering with construction is included under this Section.

3.2 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Unsuitable Material: Shall be removed from the site and disposed of by the Contractor. Should on-site material prove to be unsuitable as fill or backfill, the Contractor shall furnish suitable material at no additional expense to the Owner.
- C. Removal to Owner's Spoil Area: Transport non-combustible waste materials and unsuitable topsoil materials to designated spoil areas on Owner's property and dispose of as directed.
- D. Removal from Owner's Property: Remove waste materials and unsuitable or excess topsoil from Owner's property properly and in accordance with all ordinances and regulations.

END OF SECTION 31 1000

SECTION 31 2300

EXCAVATION & FILL

PART 1 - GENERAL

1.1 GEOTECHNICAL REPORT

A. Perform earthwork complying with the requirements of Geotechnical Report for the site.

1.2 CODES AND STANDARDS

A. Perform earthwork complying with requirements of authorities with jurisdiction.

1.3 EXISTING UTILITIES

A. Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

1.4 LIMITS OF THIS SECTION

A. This section shall include earthwork on site outside of building pad areas. Refer to structural section for building pad requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Provide approved borrow soil materials from off site when sufficient approved soil materials are not available from excavations.

2.2 SATISFACTORY SOIL MATERIALS

A. ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, or other deleterious matter.

2.3 UNSATISFACTORY SOIL MATERIALS

A. ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.

PART 3 - EXECUTIONS

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide erosion and sedimentation control measures.
- C. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- D. Protect subgrades and foundation soils from softening and damage by rain or water accumulation and from freezing temperatures or frost.

3.2 EXPLOSIVES

A. Do not use explosives.

3.3 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified and includes excavation to required subgrade elevations regardless of character of materials and obstructions encountered.

3.4 COMPACTION

- A. Unless noted differently in plans or in Geotechnical Report, place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Place evenly alongside structures and utilities to required elevations.
- B. Unless noted differently in plans or in Geotechnical Report, compact soil to not less than the following percentages of maximum dry density according to ASTM D 698:
 - 1. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer of backfill or fill material to 90 percent.
 - 2. Under walkways and pavement, compact the top 6 inches below subgrade and each layer of backfill or fill material to 95 percent.

END OF SECTION 31 2300

SECTION 31 2500

EROSION AND SEDIMENTATION CONTROLS

PART 1 – GENERAL

1.1 This section will consist of the completion and implementation of a storm water pollution prevention plan (SWPPP).

PART 2 - PRODUCTS

2.1 The contractor will be provided with a package outlining contractor requirements regarding the SWPPP. In addition, reference is made to the SWPPP construction plan prepared for this project.

PART 3 - EXECUTION

3.1 The contractor will be responsible for execution and implementation of the SWPPP, including construction of all required erosion control features, reporting to TCEQ and completion of inspection forms.

END OF SECTION 31 2500

SECTION 31 3213.19

LIME TREATED BASE COURSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item establishes the requirements for commercial lime slurry and palletized lime of the type and grade considered suitable for use in the treatment of natural or select materials or mixtures for subgrade.

1.2 BASE SPECIFICATION

A. Reference Specification for hydrated lime and lime slurry and related products shall be the "Texas Standard Specifications", latest edition as published by Texas Department of Transportation (TxDOT).

PART 2 - MATERIAL

2.1 TYPES

- A. Type B, Commercial Lime Slurry:
 - Type B, commercial lime slurry shall be a pumpable suspension of solids in water. The
 water or liquid portion of the slurry shall not contain dissolved material in sufficient
 quantity and/or nature injurious or objectionable for the purpose intended. The solids
 portion of the mixture, when considered on the basis of "solids content," shall consist
 principally of hydrated lime of a quality and fineness sufficient to meet the following
 requirements as to chemical composition and residue.
 - a. Chemical Composition The "solids content" of the lime slurry shall consist of a minimum of 70 percent by weight of calcium and magnesium oxides.
 - b. Residue The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:

Residue Retained on No. 6 Sieve - maximum 0.0 percent.

Residue Retained on No. 10 Sieve - maximum 1.0 percent.

Residue Retained on No. 30 Sieve - maximum 2.5 percent.

- 2. Type B, commercial lime slurry shall conform to one of the following two grades:
 - a. Grade 1: The "dry solids content" shall be at least 31 percent by weight of the slurry.
 - b. Grade 2: The "dry solids content" shall be at least 35 percent by weight of the slurry.
- 3. A minimum of 6% lime by dry unit weight of soil (30 lbs/sq.yd) will be required on this project.
- B. Type B, Pelletized lime will be acceptable on this project.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This item will consist of treating subgrade, subbase and base courses by the pulverization, addition of lime, mixing and compacting of the mix material to the required density. This item applies to natural ground, embankment, existing pavement, base or subbase courses placed under this contract and shall be constructed as specified herein and in conformity with the typical section, lines and grades as shown on the plan.

1.2 BASE SPECIFICATION

A. Reference Specification for hydrated lime and lime slurry and related products shall be the "Texas Standard Specifications", latest edition as published by Texas Department of Transportation (TxDOT).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Base and subbase materials shall meet the requirements shown on the plans or in the pertinent specifications.
- B. The lime shall meet the requirements of TxDOT Item 264, "Lime Slurry" for the type of lime specified.
- C. When Type B, commercial lime slurry is specified, the Contractor shall select prior to construction the grade to be used and shall notify the Owner in writing before changing from one grade to another.
- D. If the minimum design strength or percent lime to be used for the treated subgrade, existing subbase, existing base, new subbase or new base is specified, it will be determined by preliminary tests performed in accordance with recognized procedures by an independent laboratory.

2.2 EQUIPMENT

- A. Machinery, tools and equipment necessary for proper prosecution of the work shall be on the project prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.
- B. Pelletized lime shall be stored and handled in closed, weatherproof containers until immediately before distribution. If storage bins are used, they shall be completely enclosed. Pelletized lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.
- C. If lime is furnished in trucks, each truck shall have the weight of lime certified on public scales or the Contractor shall place a weight of standard platform truck scales or hopper scales at a location approved by the Engineer.
- D. If lime is furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than 5 percent net weight may be rejected and the average weight of bags in any shipment, as shown on weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. General: It is a primary requirement of this specification to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.
- B. Prior to beginning any lime treatment, the area shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans.

- C. Treatment of Materials in Place: Material to be treated shall be excavated to the secondary grade (proposed bottom of lime treatment) and removed or windowed to expose the secondary grade. Any wet or unstable materials below the secondary grade shall be corrected by scarifying, adding lime and compacted until it is of uniform stability. The excavated material shall then be spread to the desired cross-section. If the Contractor elects to use a cutting or pulverizing machine that will remove the subgrade material accurately to the secondary grade, and pulverize the material at the same time, he will not be required to expose the secondary grade or windrow the material. However, the Contractor shall be required to roll the subgrade before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will ensure that the material is cut uniformly to the proper depth and which has cutters that will place the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all time that the machine is cutting to the proper depth.
- D. Treatment for New Materials: The base or subbase materials, as provided in the governing specifications, shall be delivered, placed and spread in the required amount per station. The material shall be manipulated as specified and thoroughly mixed prior to the addition of the lime.

3.2 APPLICATION

- A. Lime shall be spread only on that area where the first mixing operation can be completed in the same working day.
- B. The application of mixing of lime with the materials shall be accomplished by the method hereinafter described as "slurry placing" unless otherwise approved by the Owner's representative.
- C. Dry Placing:
 - 1. The lime shall be spread by an approved screw type spreader box or by bag distribution at the rate shown on the plans.
 - 2. The lime shall be distributed at a uniform rate and in such manner as to reduce scattering of lime by wind to a minimum. Lime shall not be applied when wind conditions are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime. The material shall be sprinkled until proper moisture content has been secured.
- D. Slurry Placing: Lime shall be mixed with water in trucks or approved by distributors and applied as a slurry. Type B, commercial lime slurry shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime at the rate shown on the plans shall be attained by successive passes over a measured surface of roadway until the proper moisture and lime content have been secured. The distributor truck shall be equipped with an agitator which will keep the lime and water in a uniform mixture.

3.3 MIXING

- A. Mixing procedure shall be the same for "dry placing" or "slurry placing" as hereinafter described:
 - 1. Treatment for Materials in Place:
 - a. First Mixing: Material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until the homogeneous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clay or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of the lime application, brought to the proper moisture content and left to cure one to four days as directed by the Owner's representative. During the curing period, the material shall be kept moist.
 - b. After the required curing time, the material shall be uniformly mixed by approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all nonslaking aggregates obtained on the No. 4 sieve are removed, the remainder of the material shall meet the following requirements when tested dry by laboratory sieves:

Minimum passing 1- inch sieve - 100 percent.

Minimum passing No. 4 sieve - 60 percent.

2. Treatment for New Material:

a. The base or subbase material, lime and required water shall be thoroughly mixed and blended by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture is obtained. When lime is placed as a slurry and mixed by the use of blades, the material shall be bladed as the lime-water mixture is applied, and after the total amount has been placed, the mixture shall be thoroughly blended to the satisfaction of the Owner's representative.

3.4 COMPACTION

A. Compaction of the mixture shall begin immediately after final mixing and in no case later than three calendar days after final mixing. The material shall be aerated or sprinkled as necessary to provide optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted as shown on the plans. The compacted mixture shall have a uniform density of not less than 95 percent of the maximum density as determined by ASTM Designation D-1557. After each section is completed, such tests as are necessary shall be made. If nay portion fails to meet the density specified, it shall be revoked as necessary to obtain the specified density.

3.5 FINISHING, CURING AND PREPARATION FOR SURFACE

A. After the mixture has been completed, the surface shall be shaped to the required line, grades and cross-sections and then thoroughly rolled as directed with a pneumatic or other suitable roller sufficiently light to prevent hair cracking. The completed section shall then be moist cured for a minimum of seven days before further courses are added or any traffic permitted. In cases where subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to traffic two days after compaction. If the completed section has not been covered by other courses of material or pavement in seven days, it shall be sealed by an application of AC-20 asphalt at the rate of one-tenth (0.10) gallon per square yard.

3.6 MAINTENANCE

A. The Contractor shall be required to maintain the completed soil lime base within the limits of his contract, in good condition, satisfactory as to grade, crown and cross section until such time as the surface course is constructed. All irregularities or other defects that may occur shall be immediately repaired by the Contractor at his own expense. Repairs are to be made as directed by the Owner's representative and in a manner to ensure restoration of a uniform surface and durability of the portion repaired.

END OF SECTION 31 3213.19

SECTION 32 1216

ASPHALT PAVING

PART 1 - GENERAL

This item shall govern for the construction of a base course, a level-up course, a surface course or any combination of these courses as shown on the plans, each course being composed of a compacted mixture of aggregate and asphalt cement mixed hot in a mixing plant, in accordance with the details shown on the plans and the requirements herein.

PART 2 - MATERIALS

A. The Contractor shall furnish materials to the project meeting the following requirements prior to mixing. Additional test requirements affecting the quality of individual materials or the paving mixture shall be required when indicated on the plans.

2.1 AGGREGATE

- A. The aggregate shall be composed of a coarse aggregate, a fine aggregate, and if required or allowed, a mineral filler. Aggregate from each stockpile shall meet the quality requirements of Table 1 and other requirements as specified herein.
 - Coarse aggregate is defined as the part of the aggregate retained on a 1/12-inch sieve.
 The aggregate shall be natural, lightweight or manufactured, and be of uniform quality throughout. When specified on the plans, certain coarse aggregate material may be allowed, required or prohibited.
 - a. Lightweight aggregate is defined as expanded shale, clay or slate produced by the rotary kiln method. Manufactured aggregate is defined as any aggregate other than natural or lightweight.
 - b. Lightweight or manufactured materials with the same or similar gradation whose unit weight vary by more than 6.0 percent from that used in the mixture design may require a redesign.
 - c. Gravel from each source shall be so crushed as to have a minimum of 85 percent of the particles retained on the 3/16-inch sieve with two or more mechanically induced crushed faces, as determined by Test Method Tex-460-A (Part I). The material passing the 3/16-inch sieve and retained on the 1/12-inch sieve must be the product of crushing aggregate that was originally retained on the 3/16-inch sieve.
 - d. The polish value for the virgin (not previously used in construction) coarse aggregate used in the surface or finish coarse shall not be less than the value shown on the plans, when tested in accordance with Test Method Tex-438-A. Unless otherwise shown on the plans, the polish value requirement will apply only to aggregate used on travel lanes. For rated sources, the Materials and Tests Division's Rated Source Polish Value (RSVP) catalog will be used to determine polish value compliance. Unless otherwise shown on the plans, virgin coarse aggregates may be blended in accordance with Test Method Tex-438-A, Part II, Method B, to meet the polish value requirement. When blending is allowed, the blended virgin aggregates shall contain non-polishing aggregates of not less than the percent by volume of the critical size shown below for the specified mixture.

	Type C	Type D	Type F
Retained on the 3/16-inch sieve	50%	50&	
Retained on the 1/12-inch sieve			50%

- 2. The fine aggregate is defined as the part of the aggregate retained on a 1/12-inch sieve and shall be of uniform quality throughout. When specified on the plans, certain fine aggregate material may be allowed, required or prohibited. However, a maximum of 15 percent of the total virgin aggregate may be field sand or other uncrushed fine agaregate.
 - Screenings shall be supplied from sources whose coarse agareagte meets the Los Angeles abrasion and magnesium sulfate soundness loss requirements shown in Table 1, unless otherwise shown on the plans.
 - Unless otherwise shown on the plans, stone screenings are required and shall be the result of a rock crushing operation and meet the following gradation requirements, when tested in accordance with Test Method Tex-200-F, Part I.

Percent by Mass Passing the 3/8-inch sieve

Passing the 3/0-mich sieve 70 - 100 0 - 15

- Crushed gravel screenings may be used with, or in lieu of, stone screenings when shown on the plans. Crushed gravel screenings must be the product of crushing agaregate that was originally retained on the 3/16-inch sieve and meet the gradation for stone screenings shown above.
- 3. Mineral Filler. Mineral filler shall consist of thoroughly dried stone dust, Portland cement, lime, fly ash, or other mineral dust approved by the Engineer. The mineral filler shall be free from foreign matter.
 - When a specific type of mineral filler is specified on the plans, fines collected by the baghouse or other air cleaning or dust collecting equipment shall not be used to meet this requirement. When mineral filler is not specifically required, the addition of baghouse or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer. In no case shall the amount of material passing the 1/32-inch sieve exceed the tolerances of the job-mix formula or the master aradation limits.
 - b. When mineral filler is specified or allowed by the Engineer, or baghouse fines are permitted to be added to the mixture, it shall be proportioned into the mix by a vane meter or an equivalent measuring device acceptable to the Engineer. A hopper or other acceptable storage system shall be required to maintain a constant supply of mineral filler to the measuring device.
 - The measuring device for adding mineral filler shall be tied into the automatic plant C. controls so that the supply of mineral filler will be automatically adjusted to plant production and provide a consistent percentage to the mixture. When shown on the plans, the measuring device for adding baghouse fines shall have controls in the plant control room which will allow manual adjustment of feed rates to match plant production rate adjustments.
 - When tested in accordance with Test Method Tex-200-F (Part I or Part III, as d. applicable), the mineral filler shall meet the following gradation requirements, unless otherwise shown on the plans. Baghouse fines are not required to meet the gradation requirements.

	Percent by Mass
	or Volume
ch sieve	95 - 100
sch siova not loss than	75

Passing the 1/4-inc Passing the 1/16-inch sieve, not less than Passing the 1/32-inch sieve, not less than 55

TABLE 1
AGGREGATE QUALITY
REQUIREMENTS *

Requirement	Test Method	Manufactured or Natural Aggregate	Lightweight Aggregate		
COARSE AGGREGATE					
Dry Loose Unit Weight, Kg/m³ minimum	Tex-404-A	-	560		
Pressure Slaking Value, maximum	Tex-431-A	-	4		
Freeze Thaw Loss, percent, max.	Tex-432-A	1	7		
24 Hour Water Absorption, percent, maximum	Tex-433-A	-	12		
Deleterious Material, percent, maximum	Tex-217-F Part I	1.5	1.5		
Decantation, percent, maximum	Tex-217-F Part II	1.5	1.5		
Los Angeles Abrasion, percent, maximum	Tex-410-A	40	35		
Magnesium Sulfate Soundness Loss, 5 cycle, percent, maximum	Tex-411-A	30**	-		
FINE AGGREGATE					
Linear Shrinkage, maximum	Tex-107-E Part II	3	3		
COMBINED AGGREGATES ***					
Sand Equivalent Value, minimum	Tex-203-F	45	45		

^{*} Sampled during delivery to the plant or from the stockpile, unless otherwise shown on the plans.

2.2 ASPHALTIC MATERIAL

A. Asphalt cement for the paving mixture shall be of the grade shown on the plans or designated by the Engineer. The Contractor shall notify the engineer of the source of the asphaltic material prior to design of the asphaltic mixture. This source shall not be changed during the course of the project without the authorization of the Engineer. Should the source of ashaltic material be changed, the moisture resistance of the new material combination will be evaluated to verify that the requirements are met.

^{**} Unless otherwise shown on the plans.

 $^{^{***}}$ Aggregates, without added mineral filler, RAP, or additives, combined as used in the job-mix formula.

- B. Tack Coat. Asphaltic materials, shown on the plans or approved by the Engineer, shall meet the requirements AC-20 Asphalt Cement.
- C. Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coast shall be used when noted on the plans or may be used with the authorization of the Engineers.
 - 1. Unless otherwise shown on the plans, the Contractor may choose to use either lime or a liquid antistripping agent to reduce the moisture susceptibility of the aggregate.

PART 3 - PAVING MIXTURES

- A. The paving mixtures shall consist of a uniform mixture of aggregate, hot asphalt cement, and additives if allowed or required.
- B. An asphalt mixture design is a laboratory process which includes the determination of the quality of the asphalt and the individual aggregates, the development of the job-mix formula, and the testing of the combined mixture.
- C. The job-mix formula lists the quantity of each component to be used in the mix and the combined gradation of the aggregates used.
- 3.1 The Contractor shall furnish the Engineer with representative samples of the materials to be used in production. Using these materials, the mix shall be designed in accordance with Test Method Tex-204-F to conform with the requirements herein. Unless otherwise shown on the plans, the Engineer will furnish the mix design for mixtures when using 20 percent or less RAP. The Engineer may accept a design from the Contractor which was derived using these design procedures.
 - 1. The second and subsequent mixture designs, or partial designs, for each type of paving mixture which are necessitated by changes in the material or at the request of the Contractor will be charged to the Contractor when a rate is shown on the plans.
 - 2. The bulk specific gravity will be determined for each aggregate to be used in the design mixture. If the determined values vary by 0.300 or more, the Volumetric Method, Test Method Tex-204-F, Part II, will be used.
 - 3. When properly proportioned, for the type specified, the blend of aggregates shall produce an aggregate gradation which will conform to the limits of the master grading shown in Table 2. Unless otherwise shown on the plans, the gradation of the aggregate will be determined in accordance with Test Method Tex-200-F, Part I (Dry Sieve Analysis), to develop the job-mix formula.
 - 4. The master grading limits for the appropriate type and the proposed job-mix formula will be plotted on a gradation chart with sieve sizes raised to the 0.45 power. This plot must show that the proposed job-mix formula is within the limits of the master grading. Gaps in gradation shown by this plot should be avoided.
 - 5. The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with Test Method Tex-207-F, and shall not be less than the value indicated in Table 2.
 - 6. To substantiate the design, trial mixtures shall be produced and tested using all of the proposed project materials and equipment prior to any placement. The Engineer may waive trial mixtures if similar designs have proven satisfactory.

3.2 DENSITY

- A. The mixture shall be designed to produce an acceptable mixture at an optimum density of 96.0 per cent, when tested in accordance with Test Method Tex-207-F and Test Method Tex-227-F. The operating range for control of laboratory density during production shall be optimum density plus or minus 1.5 percent.
 - 1. Laboratory density is a mixture design and process control parameter. If the laboratory density of the mixture produced has a value outside the range specified above, the Contractor shall investigate the cause and take corrective action. If three (3) consecutive test results fall outside the specified range, production shall cease unless test results or other information indicate, to the satisfaction of the Engineer, that the next mixture to be produced will be within the specified range.

3.3 STABILITY

A. The materials used in the mixture design shall produce a mixture with a stability value of at least 35, unless otherwise shown on the plans, when tested in accordance with Test Method Tex-208-F.

3.4 JOB-MIX FORMULA FIELD ADJUSTMENTS

- A. The Contractor shall produce a mixture of uniform composition closely conforming to the approved job-mix formula.
 - 1. If, during initial days of production, it is determined that adjustments to the mixture design job-mix formula are necessary to achieve the specified requirements, or to more nearly match the aggregate production, the Engineer may allow adjustment of the mixture design job-mix formula within the following limits without a laboratory redesign of the mixture. The adjusted job-mix formula shall not exceed the limits of the master grading for the type of mixture specified nor shall the adjustments exceed five (5) percent on any one sieve, 1/2-inch size and larger, or three (3) percent on the sieve sizes below the 1/2-inch sieve.
 - 2. When the considered adjustments exceed either the five (5) or three (3) percent limits, and the Engineer determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.
 - 3. The asphalt content will be adjusted as deemed necessary by the Engineer to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

3.5 TYPES

A. The aggregate gradation of the job-mix formula shall conform to the master grading limits shown in Table 2 for the type mix specified on the plans.

Master

Grading Passing by Mass or	Percent	
Sieve Size	Α	D
	Coarse Base	Fine Surface
1.5-inch	100	

TABLE 2

Size	Coarse Base	Fine Surface
1.5-inch	100	
1.25-inch	95-100	
1.00-inch		
7/8-inch	70-90	
10/16-inch		
1/2-inch	50-70	100
3/8-inch		85-100
1/4-inch		
3/16-inch	30-50	50-70
1/12-inch	20-34	32-42
3/32-inch	5-20	11-26
1/16-inch	2-12	4-14
1/32-inch	1-6*	1-6*
VMA % minimum	11	14

PART 4 - EQUIPMENT

4.1 GENERAL

A. All equipment for the handling of all materials, mixing, placing and compacting of the mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective and potentially having a negative effect on the quality of the paving mixture or ride quality will not be allowed.

4.2 MIXING PLANTS

- A. Mixing plants may be the weigh-batch type, the modified weigh-batch type, the drum-mix type, or the specialized recycling type. All plants shall be equipped with satisfactory conveyors, power units, mixing equipment, aggregate handling equipment, bins and dust collectors.
 - It shall be the Contractor's responsibility to provide safe and accurate means to enable inspection forces to take all required samples, to provide permanent means for checking the output of any specified metering device, and to perform calibration and mass checks as required by the Engineer. When cold feed belt sampling is to be used for gradation testing, occasional stoppage of the belt may be necessary unless other means of sampling are approved by the Engineer.

4.3 ASPHALTIC MATERIAL HEATING EQUIPEMNT

A. Asphaltic material heating equipment shall be adequate to heat the required amount of ashphaltic material to the desired temperature. The heating apparatus shall be equipped with a continuously recording thermometer with a 24-hour chart that will record the temperature of the asphaltic material at the location of highest temperature.

4.4 SPREADING AND FINISHING MACHINE

- A. The spreading and finishing machine shall be approved by the Engineer and shall meet the requirements indicated below.
- B. The spreading and finishing machine shall be equipped with a heated compacting screed. It shall produce a finished surface meeting the requirements of the typical cross sections and the surface test.
 - 1. Extensions added to the screed shall be provided with the same compacting action and heating capability as the main screed unit, except for use on variable depth tapered areas and/or as approved by the Engineer.
 - The spreading and finishing machine shall be equipped with an approved automatic dual longitudinal screed control system and automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a stringline, ski, mobile stringline, or matching shoe.
 - 3. The Contractor shall furnish all equipment required for grade reference. It shall be maintained in good operating condition by personnel trained in the use of this type of equipment.
 - 4. The grade reference used by the Contractor may be of any type approved by the Engineer. Control points, if required by the plans, shall be established for the finished profile in accordance with Item 5, "Control of the Work." These points shall be set at intervals not to exceed 50 feet. The Contractor shall set the grade reference from the control points. The grade reference shall have sufficient support so that the maximum deflection shall not exceed 1/12-inch between supports.
- C. The tractor unit shall be equipped with a hydraulic hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded
 - 1. No portion of the mass of hauling equipment, other than the connection, shall be supported by the asphalt paver. No vibrations or other motions of the loading equipment, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.

- 2. No portion of the mass of hauling equipment, other than the connection, shall be supported by the asphalt paver. No vibrations or other motions of the loading equipment, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.
- 3. The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel to obtain the desired lines and grades without resorting to hand finishing will not be allowed.

4.5 MATERIAL TRANSFER EQUIPMENT

- A. Equipment to transfer mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless otherwise shown on the plans. A specific type of material transfer equipment shall be required when shown on the plans.
 - Windrow Pick-Up Equipment. Windrow pick-up equipment shall be constructed in such a
 manner that substantially all the mixture deposited on the roadbed is picked up and
 loaded into the spreading and finishing machine. The mixture shall not be contaminated
 with foreign material. The loading equipment shall be designed so that it does not
 interfere with the spreading and finishing machine in obtaining the required line, grade
 and surface without resorting to hand finishing.
 - 2. Material Feeding System. Material feeding systems shall be designed to provide a continuous flow of uniform mixture to the spreading and finishing machine. When use of a material feeding system is required on the plans, it shall meet the storage capacity, remixing capability, or other requirements shown on the plans.

4.6 MOTOR GRADER

A. The motor grader, when used, shall be a self-propelled power motor grader and shall be equipped with smooth tread pneumatic tired wheels unless otherwise directed. It shall have a blade length of not less than 12 feet and a wheelbase of not less than 16 feet.

4.7 ROLLERS PROVIDED SHALL MEET THE REQUIREMENTS FOR THEIR TYPE AS FOLLOWS:

- A. Pneumatic-Tire Roller. The roller shall be an acceptable medium pneumatic tire roller. Unless otherwise specified on the plans. Pneumatic-tire rollers used for compaction shall provide a minimum 80 psi ground contact pressure. When used for kneading and sealing the surface only, they shall provide a minimum of 55 psi ground contact pressure.
- B. Two-Axle Tandem Roller. This roller shall be an acceptable self-propelled tandem roller weighing not less than 16,000 lbs.
- C. Three-Wheel Roller. This roller shall be an acceptable self-propelled three wheel roller weighing not less than 20,000 lbs.
- D. Three-Axle Tandem Roller. This roller shall be an acceptable self-propelled three axle roller weighing not less than 20,000 lbs.
- E. Trench Roller. This roller shall be an acceptable self-propelled trench roller equipped with a sprinkler for keeping the wheels wet and an adjustable road wheel so that the roller may be kept level during rolling. The drive wheel shall be not less than 2 feet wide. The roller under working conditions shall produce not less than 3900 lbs per foot of roller width and be so geared that a speed of approximately 2 miles per hour is obtained in low gear.
- F. Vibratory Steel-Wheel Roller. This roller shall have a minimum mass of 12,000 lbs. The compactor shall be equipped with amplitude and frequency controls and shall be specifically designed to compact the material on which it is used.
- 4.8 When directed by the engineer, the contractor shall provide acceptable 10 feet straightedges for surface testing. Satisfactory templates shall be provided as required by the engineer.
- 4.9 When permitted by the engineer, equipment other than that specified herein which will consistently produce satisfactory results may be used.

PART 5 - STOCKPILING, STORAGE AND MIXING

5.1 STOCKPILING OF AGGREGATES

- A. Weigh-Batch Plant. Prior to stockpiling of aggregates, the area shall be cleaned of trash, weeds, grass and shall be relatively smooth and well drained. The stockpiling shall be done in a manner that will minimize aggregate degradation, segregation, mixing of one stockpile with another, and will not allow contamination with foreign material.
 - 1. The plant shall have at least a two-day supply of aggregates on hand before production can begin and at least a two-day supply shall be maintained through the course of the project, unless otherwise directed by the Engineer.
 - 2. No stockpile shall contain aggregate from more than one source.
 - 3. Coarse aggregates for mixture Types "A", "B" and "C" shall be separated into at least two stockpiles of different gradation, such as a large coarse-aggregate and a small-coarse-aggregate stockpile, except when the use of large percentage of RAP preclude the need for two virgin coarse aggregate stockpiles.
 - 4. When shown on the plans, coarse aggregates for Type "D" mixtures shall also be separated into at least two stockpiles.
 - 5. No coarse-aggregate stockpile shall contain more than 15 percent by mass of material that will pass a 1/12-inch sieve.
 - 6. Fine-aggregate stockpiles may contain coarse aggregate in amounts up to 20 percent by mass. This requirement does not apply to stone screenings stockpiles.
 - 7. When required by the Engineer, additional material shall not be added to stockpiles that have previously been sampled for approval.
 - 8. Equipment of an acceptable size and type shall be furnished to work the stockpiles and prevent segregation and degradation of the aggregates.
- B. Modified Weigh-Batch Plant. The stockpiling requirements for aggregate shall be the same as required for a drum-mix type plant.
- C. Drum-Mix Plant. When a drum-mix plant is used, the following stockpiling requirements for coarse aggregates shall apply in addition to the aggregate stockpiling requirements listed previously.
 - Once a job-mix formula has been established, the virgin coarse aggregates delivered to
 the stockpiles shall not vary on any grading size fraction by more than plus or minus eight
 (8) percentage points from the percentage found in the samples submitted by the
 Contractor and upon which the job-mix formula was based. Should the gradation of virgin
 coarse aggregates in the stockpiles vary by more than the allowed tolerance, the
 Engineer may stop production. If production is stopped, new aggregates shall be
 furnished that meet the gradations of the aggregates submitted for the job-mix formula, or
 a new mix design shall be formulated.
 - 2. When the volume of production from a commercial plant makes sampling of all coarse aggregate delivered to the stockpiles impractical, cold feeds will be sampled to determine stockpile uniformity. Should this sampling prove the stockpiles non-uniform beyond the acceptable tolerance, separate stockpiles which meet these specifications may be required.
- D. Specialized Recycling Plant. The stockpiling requirements for aggregate shall be the same as required for drum-mix type plant.

5.2 STORAGE AND HEATING OF ASPHALTIC MATERIALS

A. The asphaltic material storage capacity shall be ample to meet the requirements of the plant. Asphalt shall not be heated to a temperature in excess of that specified. All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operate in such a manner that there will be no contamination with foreign matter.

5.3 FEEDING AND DRYING OF AGGREGATE

A. The feeding of various sizes of aggregate to the dryer shall be done through the cold aggregate bins and the proportioning device in such a manner that a uniform and constant flow of materials in the required proportions will be maintained. The aggregate shall be dried and heated to the temperature necessary to produce a mixture having the specified temperature.

5.4 MIXING AND STORAGE

- A. Weigh-Batch Plant. In introducing the batch into the mixer, all aggregate shall be introduced first and shall be mixed thoroughly for a minimum period of five (5) seconds to uniformly distribute the various sizes throughout the batch before the asphaltic material is added. The asphaltic material shall then be added and the mixing continued for a wet mixing period of not less than 15 seconds. The mixing period shall be increased if, in the opinion of the Engineer, the mixture is not uniform or the aggregates are not properly coated.
 - 1. Temporary storing or holding of the asphaltic mixture by the surge-storage system will be permitted during the normal day's operation. Overnight storage will not be permitted unless authorized in the plans or by the Engineer. The mixture coming out of the surge-storage bin shall be of equal quality to that coming out of the mixer.
- B. Modified Weigh-Batch Plant. The mixing and storage requirements shall be the same as is required for a standard weigh-batch plant.
- C. Drum-Mix Plant. The amount of aggregate and asphaltic material entering the mixer and the rate of travel through the mixing unit shall be so coordinated that a uniform mixture of the specified grading and asphalt content will be produced.
 - 1. Temporary storing or holding of the asphaltic mixture by the surge-storage system will be required during the normal day's operation. Overnight storage will not be permitted unless authorized in the plans or by the Engineer. The mixture coming out of the surge-storage bin shall be of equal quality to that coming out of the mixer.
- D. Specialized Recycling Plant. The mixing and storage requirements shall be the same as that stated for the drum-mix plant.
- E. Discharge Temperature. The Engineer will select the target discharge temperature of the mixture between 248° F and 347° F. The mixture, when discharged from the mixture, shall not vary from this selected temperature more than 59° F, but in no case shall the temperature exceed 356° F.
- F. Moisture Content. The mixture produced from each type of mixer shall have a moisture content not greater than one (1) percent by mass when discharged from the mixer, unless otherwise shown on the plans and/or approved by the Engineer. The moisture content shall be determined in accordance with Test Method Tex-212-F.

PART 6 - CONSTRUCTION METHODS

6.1. GENERAL

- A. It shall be the responsibility of the Contractor to produce, transport, place and compact the specified paving mixture in accordance with the requirements herein.
 - 1. The asphaltic mixture, when placed with a spreading and finishing machine, or the tack coat shall not be placed when the air temperature is below 50° F and is falling, but it may be placed when the air temperature is above 41° F and is rising.
 - 2. The air temperature shall be taken in the shade away from artificial heat.
 - 3. Mat thicknesses of 1.5 inches and less shall not be placed when the temperature of the surface on which the mat is to be placed is below 50° F.
 - 4. Mixtures with lightweight coarse aggregate shall not be placed when the temperature of the surface on which the mat is to be placed is below 50° F.
 - 5. Additional surface temperature requirements may be shown on the plans.
 - 6. It is further provided that the tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the Engineer, are suitable.

7. If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is 50° F or more below the selected discharge temperature established by the Engineer, all or any part of the load may be rejected and payment will not be made for the rejected material.

6.2 TACK COAT

A. The surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat using asphaltic materials of this specification. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed 0.05 gallon residual asphalt per 10 ft² of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform application of tack coat. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. The tack coat shall be rolled with a pneumatic tire roller when directed by the Engineer.

6.3 TRANSPORTING ASPHALTIC CONCRETE

A. The asphaltic mixture shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered is placed and all rolling completed during daylight hours unless otherwise shown on the plans. In cool weather or for long hauls, covering and insulating of the truck bodies may be required. If necessary, to prevent the mixture from adhering to the body, the inside of the truck may be given a light coating of release agent satisfactory to the Engineer.

6.4 PLACING

- A. The asphaltic mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition, the placing of the asphaltic mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the mat.
 - 1. Unloading into the finishing machine shall be controlled so that bouncing or jarring the spreading and finishing machine shall not occur and the required lines and grades shall be obtained without resorting to hand finishing.
 - 2. Unless otherwise shown on the plans, dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with windrow pick-up equipment will be permitted. The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in the accumulation and subsequent shedding of accumulated material into the asphaltic mixture will not be permitted.
- B. When approved by the Engineer, level-up courses may be spread with a motor grader.
- C. The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plat production rate, hauling capability, and roller train capacity to result in a continuous operation. The speed shall be slow enough that stopping between trucks is not ordinarily required. If, in the opinion of the Engineer, sporadic delivery of material is adversely affecting the mat, the Engineer may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the paver.

- 1. The hopper flow gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. These shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat, as approved by the Engineer. Augers should be kept approximately one-half to three-quarters full of mixture at all times during the paving operation.
- D. When the asphaltic mixture is placed in a narrow trip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer.
- E. Adjacent to flush curbs, gutters and structures, the surface shall be finished uniformly high so that when compacted it will be slightly above the edge of the curb or structure.
- F. Construction joints of successive courses of asphaltic material shall be offset at least 6 inches. Construction joints on surface courses shall coincide with lane lines, or as directed by the Engineer.
- G. If a pattern of surface irregularities or segregation is detected, the Contractor shall make an investigation into the causes and immediately take the necessary corrective action. With the approval of the Engineer, placement may continue for no more than one full production day from the time the Contractor is first notified and while corrective actions are being taken. If the problem still exists after that time, paving shall cease until the Contractor further investigates the causes and the Engineer approves further corrective action to be taken.

6.5 COMPACTING

- A. The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the compaction and cross section of the finished paving mixture meeting the requirements of the plans and specifications.
- B. When rolling with the three-wheel, tandem or vibratory rollers, rolling shall start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least 1 foot, unless otherwise directed by the Engineer. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the high side, unless otherwise directed by the Engineer.
 - 1. When rolling with vibratory steel-wheel rollers, equipment operation shall be in accordance with the manufacture's recommendations, unless otherwise directed by the Engineer. Vibratory rollers shall not be left vibrating while not rolling or when changing directions. Unless otherwise shown on the plans or approved by the Engineer, vibratory rollers shall not be allowed in the vibrating mode on mats with a plan depth of less than 1.5 inches.
 - 2. The motion of the rollers shall be slow enough to avoid other than usual initial displacement of the mixture. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer. The roller shall not be allowed to stand on pavement, which has not been fully compacted. To prevent adhesion of the surface mixture to the steel-wheel rollers, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.
- C. The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.
- D. Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory compaction cannot be obtained with the approved rollers.

6.6 IN-PLACE COMPACTION CONTROL

In-place compaction control is required for all mixtures. Unless otherwise shown on the plans, air void control shall be required.

- A. Air Void Control. The Contractor shall be responsible for determining the number and type of rollers to be used to obtain compaction to within the air void range required herein. The rollers shall be operated in accordance with the requirements of this specification and as approved by the Engineers.
 - 1. Unless otherwise shown on the plans, rolling with a pneumatic-tire roller to seal the surface shall be provided. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks.
 - 2. Asphaltic concrete shall be placed and compacted to contain from three (3) to six (6) percent air voids. A troxler nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project roadway specimens shall be used. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at his expense in a rolling pattern.
 - 3. If the percent air voids in the compacted placement is greater than six (6) percent but is 7 percent or less, production may proceed with subsequent changes in the construction operations and/or mixture. If the air void content is not reduced to between three (3) and six (6) percent within one production day from the time the Contractor is notified, production shall cease. At that point, a test section as described below shall be required.
 - 4. If the percent air voids is more than 7 percent, production shall cease immediately and a test section shall be required as described below.
 - 5. In either case, the Contractor shall only be allowed to place a test section of one lane width, not to exceed 1000 feet in length, to demonstrate that compaction to between three (3) and six (6) percent air voids can be obtained. This procedure will continue until a test section with three (3) to six (6) percent air voids can be produced. Only two (2) test sections per day will be allowed. When a test section producing satisfactory air void content is placed, full production may then resume.
 - 6. Increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed.
 - 7. If the percent air voids is determined to be less than three (3) percent, immediate adjustments shall be made to the plant production by the Contractor, as approved by the Engineer so that an adequate air void level results.
 - 8. The Contractor is encouraged to perform supplemental compaction testing for his own information.
 - 9. Rolling patterns shall be established by the Contractor as outlined in Test Method Tex-207-F, Part IV, to achieve the maximum compaction, unless otherwise directed by the Engineer. The selected rolling pattern shall be followed unless changes in the mixture or placement conditions occur which affect compaction. When changes in the mixture or placement conditions occur, a new rolling pattern shall be established.
- B. Compaction Cessation Temperature. Regardless of the method required for in-place compaction control, all rolling for compaction shall be completed before the mixture temperature drops below 176° F.

6.7 OPENING TO TRAFFIC

- A. The pavement shall be opened to traffic when directed by the Engineer. The Contractor's attention is directed to the fact that all construction traffic allowed on the pavement open to the public will be subject to the State laws governing traffic on highways.
- B. If the surface ravels, flushes, ruts or deteriorates in any manner prior to final acceptance of the work, it will be the Contractor's responsibility to correct this condition at his expense, to the satisfaction of the Engineer and in conformance with the requirements of this specification.
- C. Measurement. The thickness of asphaltic concrete will be measured using a gauge to verify the 2" depth.

END OF SECTION 32 1216

SECTION 32 1313

PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete, integral curbs, gutters and roads.

1.2 REFERENCES

- A. ACI 301 Specifications for Structural Concrete for Buildings.
- B. ACI 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ANSI/ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- D. ANSI/ASTM D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- E. ASTM A615 Deformed and Plain Billet-Steel for Concrete Reinforcement.
- F. ASTM C33 Concrete Aggregates.
- G. ASTM C94 Ready Mix Concrete.
- H. ASTM C150 Portland Cement.
- I. ASTM C260 Air-Entraining Admixtures for Concrete.
- J. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete.
- K. ASTM C494 Chemical Admixtures for Concrete.
- L. FS TT-C-800 Curing Compound, Concrete, for New and Existing Surfaces.
- M. Reference Specification for portland cement concrete and related products shall be the "Texas Standard Specifications", latest edition as published by the Texas Department of Transportation (TxDOT).

1.3 SUBMITTALS

- A. Product Data: Provide data on joint filler admixtures curing compounds.
- B. Project Data: Provide concrete mix design.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain cementitious materials from same source throughout.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable standards for paving work on public property.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Form Materials: Conform to ACI 301.
- B. Joint Filler: ANSI/ASTM D1751 D1752 Asphalt Board type; 1/2 inch thick.

2.2 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615; 60 yield grade; deformed billet steel bars; unfinished finish.
- B. Dowels: ASTM A615; 40 ksi (276 MPa) yield grade, plain steel, unfinished finish.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150 Normal Type I Portland type, grey color.
- B. Fine and Coarse Mix Aggregates: ASTM C33.

- C. Water: Potable, not detrimental to concrete.
- D. Air Entrainment: ASTM C260.

2.4 ACCESSORIES

A. Curing Compound: FS TT-C-800, Type 1, 30 percent solids ASTM C309, Type 1, Class A.

2.5 CONCRETE MIX – BY PERFORMANCE CRITERIA

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Select proportions for normal weight concrete in accordance with ACI 301 Method 3.
- C. Provide concrete to the following criteria as shown on plans:
 - 1. Compressive Strength: 3000 psi @ 28 days.
 - a. Average slump slip form paving: 3 in.

Maximum slump slip form paving: 4 in.

Average slump hand formed paving: 4 in.

Maximum slump hand formed paving: 5 in.

Slump for sidewalk, separate curb & gutter, and other miscellaneous concrete: As specified by Owner.

- b. Maximum Water/Cement Ratio: 0.58.
- c. Minimum Bags Cement per C.Y.: 5.0; min 470 lbs total cementions material.
- 2. Compressive Strength: 3600 psi @ 28 days.
 - a. Slump: 3 to 4 inches.
 - b. Maximum Water/Cement Ratio: 0.53.
 - c. Minimum Bags Cement per C.Y.: 6.0; min 564 lbs total cementions material.
- D. Use accelerating admixtures in cold weather only when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by Engineer.
- F. Use set retarding admixtures during hot weather only when approved by Engineer.
- G. With the approval of the Owner, fly ash may be used in all classes of concrete to replace a portion of the Portland cement in a mix design. Unless otherwise approved by the Owner, the maximum cement reduction shall not exceed 25-percent by weight per cubic-yard of concrete. If historical data and general practice in locality usage substantiates fly ash concrete using higher percentages, Contractor may submit written request to Owner for review. Fly ash replacement shall be on a weight basis. The minimum replacement ratio shall be 1.0-pounds of fly ash per 1.0-pounds (1kg-per-1kg) of cement replaced.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify base conditions.
- B. Verify compacted subgrade granular base stabilized soil is acceptable and ready to support paving and imposed loads.
- C. Verify grades and elevations of base are correct.

3.2 SUBBASE

A. Prepare subbase in accordance with plan details

3.3 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole catch basin frames with oil to prevent bond with concrete pavement.
- C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

- A. Place and secure forms to correct location, dimension, and profile.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Interrupt reinforcement at contraction expansion joints.
- C. Place dowels reinforcement to achieve pavement and curb alignment as detailed.
- D. Provide doweled joints 12 inches o.c. at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.

3.6 PLACING CONCRETE

- A. Ensure reinforcement, inserts, embedded parts, formed joints and structures are not disturbed during concrete placement.
- Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

- A. Place expansion/contraction joints as shown on plans. Align curb, gutter, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/2 inch for sealant placement.
- C. Provide scored sawn joints as shown on plans in standard curb and curb and gutter.
- D. Provide keyed joints as indicated.

3.8 FINISHING

- A. Area Paving: Light broom.
- B. Sidewalk Paving: Light broom, radius to 1/2 inch radius, and trowel joint edges.
- C. Curbs and Gutters: Light broom.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the General Conditions.
- B. Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed each day.
- C. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.
- D. One slump test will be taken for each set of test cylinders taken.
- E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.10 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION 32 1313

SECTION 32 9201

SEED ESTABLISHMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil Preparation
 - 2. Seed Mixes
 - 3. Hydro-mulch Cap
 - 4. Temporary Irrigation

1.2 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Planting Soil: Native topsoil, stripped during mass grading, and re-spread at a depth of 8" in all areas to receive seed mixes.
- C. Subgrade: Surface or elevation of subsoil after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.3 SUBMITTALS

- A. Any deviation from this specification and drawings must be approved in writing by the Owner via submittal.
- B. Product Data: For each type of product indicated on drawings.
- C. Product certificates.
- D. Soil tests per 1.4B.
- E. Planting Schedule: Indicating anticipated planting dates for each type of planting.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Topsoil Analysis: Contractor shall furnish soil analysis for existing stockpiled topsoil that will be reused. Test shall be performed by a qualified soil-testing laboratory, such as the Texas A&M Extension service, and evaluated for 'pasture suitability'.

1.5 MAINTENANCE SERVICE

A. Seed Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable seed coverage is established and accepted by the Owner, but not for less than three months.

1.6 WARRANTY

- A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - 2. Warranty Period from Date of Substantial Completion:
 - a. Seeded areas: Twelve months.

PART 2 - PRODUCTS

2.1 SEED

A. As indicated on the plans.

2.2 HYDRO-MULCH CAP

A. Pro Matrix by Profile. Or approved equal. Application rate per manufacturer.

2.3 TOPSOIL

- A. On site soil, stripped prior to mass grading.
- B. Topsoil Source: Reuse surface soil stockpiled on-site. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
- C. 6" minimum profile for all areas to receive seed.

2.4 FERTILIZER

A. Commercial variety at the rates recommended from the soil test in 1.4.B.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. Newly Graded Topsoil: Finish grade by removing stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- C. Moisten prepared seed areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.2 SEED INSTALLATION

- A. Seeding in large open areas: Contractor shall seed the mixes in this specification at the rates described in 2.1.1. Seed the grass mixes at the rates indicated on plans with Culti-packer or Drill Seeding methods to ensure optimum seed to soil contact before application of Hydro-Mulching.
- 3.3 HYDRO-MULCH: Apply over installed seed per 2.2.A.

3.4 TEMPORARY IRRIGATION

- A. The Contractor shall utilize temporary irrigation by any method approved by the Owner's Representative on the condition that planting establishment and Owner acceptance is the sole responsibility of the Contractor. See 1.5 for maintenance period.
- B. The Planting Plan identifies areas that are to receive vegetation and temporary watering for establishment.

3.5 SATISFACTORY SEED

A. Satisfactory Seeded Areas: A healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 8 by 8 inches that has been mowed at least twice. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

END OF SECTION 32 9201

SECTION 32 9300

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Groundcovers.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.
- B. Handle planting stock by root ball.
- C. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1.6 WARRANTY

- A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Period from Date of Substantial Completion:
 - a. Trees: Twelve months.

1.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 - 1. Maintenance Period for Trees and Plants: Twelve months from date of planting completion.

PART 2 - PRODUCTS

2.1 TREE AND PLANT MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- C. Provide container-grown trees.
- D. Plant sizes indicated on Drawings are sizes after pruning.

2.2 TOPSOIL

- A. Topsoil:
 - Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

2.3 FERTILIZER

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Compost Living Earth compost or approved equal.

2.4 MULCHES

- A. Organic Mulch: Ground or shredded native tree trimmings, that has been composed for 6 months minimum.
- B. Stone Mulch: As indicated on the plans.

PART 3 - EXECUTION

3.1 TREES AND PLANTS

- A. Excavation of Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation. Auger excavation is prohibited.
 - 1. Excavate as indicated on plans.
- B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- C. Stock with Root Balls: Set trees and plants plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - Container Grown: Carefully remove root ball from container without damaging root ball or plant.
- D. Organic Mulching: Apply 3-inch average thickness of organic mulch. Do not place mulch within 3 inches of trunks or stems.

3.2 TREE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

3.3 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.

3.4 PLANT MAINTENANCE

- A. Tree and Plant Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep and plants free of insects and disease.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 32 9300

SECTION 33 1000

WATER UTILITIES

PART 1 - GENERAL

- 1.1 System Performance Requirements: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.
 - A. Underground Piping: 150 psig.
 - B. Underground Piping, Downstream of Fire Department Connections: 150 or 200 psig as noted.
 - 1. Submit product data and shop drawings.
 - 2. Comply with standards of authorities having jurisdiction.
 - 3. Comply with NFPA 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

- 2.1 Pipes and Tubes: The applications of the following pipe and tube materials are indicated in the "Piping Applications" paragraph.
 - A. Polyvinyl Chloride (PVC) Pipe: AWWA C900; Class 150 or 200 psig as noted; with bell end and ASTM F 447 elastomeric seal gasket, and plain end for PVC elastomeric gasket fittings. Include NSF 14 pipe marking "NSF-pvc cto only."
- Joining Materials: The applications of the following joining materials are indicated in the "Piping Applications" paragraph.
 - A. Ductile-Iron Fittings: The following materials apply:
 - 1. Push-On Joints: AWWA C111 rubber gaskets and lubricant.
 - 2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
 - 3. Mechanical Restrained Joint: AWWA C111.
 - B. Solder Filler Metal: ASTM B 32, Alloys Sn95, Sn94, or E.
- 2.3 Potable Water, Nonrising Stem Gate Valves 3 Inches and Larger: AWWA C500 or AWWA C509, cast-iron or ductile-iron body and bonnet, stem nut, 200-psig working pressure, mechanical joint ends.
- 2.4 Fire Protection, Nonrising Stem Gate Valves 4 Inches and Larger: UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig working pressure, mechanical joint ends. Provide with flanged ends for pit installation.
- 2.5 Nonrising Stem Gate Valves, 2 Inches and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, nonrising copper-silicon alloy stem, brass packing gland, polytetrafluoroethylene (PTFE)-impregnated packing, and malleable-iron handwheel.
- 2.6 Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
 - A. Provide a steel tee-handle operating wrench with each valve box.
- 2.7 Indicator Posts: UL 789, FM-approved, vertical type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of bury of valve.

- 2.8 Curb Stops: Bronze body, ground key plug or ball, and wide tee head, with inlet and outlet to match service piping material.
- 2.9 Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover having lettering "WATER," and bottom section with base of size to fit over curb stop and barrel approximately 3 inches in diameter.
 - A. Provide steel tee-handle shutoff rod with each service box.
- 2.10 Service Clamps and Corporation Stops: Complete assembly, including service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.
- 2.11 Water Meter in accordance with Local City Standards.
- 2.12 Meter Box: Cast-iron body, cast-iron cover having lettering "WATER METER," and base section of length to fit over service piping. Base section is open at bottom, slotted, and may be cast iron, polyvinyl chloride (PVC), or piece of clay or other pipe.

PART 3 - EXECUTION

- 3.1 Excavation, trenching, and backfilling are specified in Division 31 Section 31 0000 "Earthwork."
- 3.2 Extend water system piping and connect to water supply source and building water distribution and fire protection systems.
- 3.3 Install restrained joints for buried piping within 5 feet (1.5 m) of building. Use restrained-joint pipe and fittings, thrust blocks, anchors, tie-rods and clamps, and other supports at vertical and horizontal offsets.
- 3.4 Piping Applications: Refer to "Products" article for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications.
 - A. Use pipe, tube, fittings, and joining methods according to following applications.
 - 1. 3 Inches and Smaller: Copper tube, Type L (Type B), copper tube fittings, and soldered joints.
 - 2. 4 Inches to 8 Inches: Class 200, ductile-iron pipe, ductile-iron or gray-iron fittings, and push-on or mechanical joints.
 - 3. 4 Inches to 8 Inches: AWWA C900, Class 200 polyvinyl chloride (PVC) plastic pipe, AWWA C900 PVC fittings, and gasketed joints.
- 3.5 Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - A. Buried Valves 3 Inches and Larger: AWWA, gate valves, nonrising stem, with valve box.
 - B. Buried Valves 4 Inches and Larger: UL/FM, gate valves, nonrising stem, with indicator post.
 - C. Meter Box Installation, Valves 2 Inches and Smaller: MSS, nonrising stem gate valves.
- 3.6 Construct joints according to the following:
 - A. Ductile-Iron Piping Gasketed Joints: Construct joints according to AWWA C600.
 - B. Threaded Joints: Apply tape or joint compound and apply wrench to valve ends into which pipes are being threaded.
 - C. Copper Tube and Fittings, Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter "The Soldering of Pipe and Tube."
 - D. AWWA Polyvinyl Chloride (PVC) Piping Gasketed Joints: Use AWWA C900 joining materials. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

- 3.7 Install fittings for changes in direction and branch connections.
- 3.8 Install unions, in piping 2 inches (50 mm) and smaller, adjacent to each valve.
- 3.9 Install piping according to the following:
 - A. Water Main Connection: Tap water main with size and in location as indicated according to requirements of water utility.
 - 1. Install stainless steel tapping sleeve and tapping valve according to manufacturer's installation instructions.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Install gate valve onto tapping sleeve. Comply with AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
 - 4. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water service piping.
 - 5. Install service clamps and corporation stops in size, quantity, and arrangement required by utility company standards and according to manufacturer's installation instructions.
 - 6. Install service clamps on pipe to be tapped. Position outlet for corporation stop.
 - 7. Install corporation stops into service clamps. Install valve with stem pointing up and with cast-iron valve box.
 - 8. Install curb stop in service piping with head pointing up and with cast-iron service box.
 - 9. Use drilling machine compatible with service clamp and corporate stop. Drill hole in main. Remove drilling machine and connect water service piping.
 - B. Comply with requirements of NFPA 24 for materials and installation.
 - C. Install ductile-iron pipe and ductile-iron and cast-iron fittings according to AWWA C600.
 - D. Install copper tube and wrought-copper fittings according to CDA No. 404/0 "Copper Tube Handbook."
 - E. Install AWWA polyvinyl chloride (PVC) plastic pipe according to AWWA M23.
 - F. Bury piping at minimum depth of 36 inches below finished grade and not less than 18 inches below average local frost depth.
- 3.10 Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.
 - A. Gasketed-Joint, Ductile-Iron Piping: According to AWWA C600.
 - B. Gasketed-Joint, Polyvinyl Chloride (PVC) Piping: According to AWWA M23.
 - C. Fire Service Piping: According to NFPA 24.
 - D. Apply full coat of corrosion-retarding material to surfaces of installed ferrous anchorage devices.
- 3.11 Valve Applications: Use mechanical-joint-end valves for 3-inch and larger buried installation. Use threaded- and flanged-end valves for installation in pits and inside building. Use nonrising stem UL/FM gate valves for installation with indicator posts. Use bronze corporation stops and valves, with ends compatible with piping, for 2-inch and smaller installation.
 - A. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
 - B. UL/FM-Type Gate Valves: Comply with NFPA 24.
 - 1. Install buried valves with stem pointing up and with vertical cast-iron indicator post.
 - C. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's installation instructions. Install buried curb stops with head pointed up and with cast-iron curb box.
- 3.12 AWWA-Type Fire Hydrant Installation: Comply with AWWA M17. Install with gate valve and provision for drainage as indicated. Install Meuller "Centurion", Clow "Medallion", or approved equal.

- 3.13 Install water meters, piping, and specialties according to the specified requirements.
 - A. Water Meter: Install displacement (disc)-type water meters 2-inch size and smaller in meter boxes with shutoff valve on meter inlet. Include valve on meter outlet and valved bypass around meter when indicated.
 - B. Install continuous tracer wire during back-filling of trench for underground water piping. Locate 12-inches above pipe directly over piping.

END OF SECTION 33 1000

SECTION 33 3000

SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

- 1.1 Submittals: Submit the following:
 - A. Product data for sanitary sewerage piping specialties.
 - B. Shop drawings for precast concrete sanitary manholes, including frames and covers.
 - C. Shop drawings for cast-in-place concrete or field erected masonry sanitary manholes, including frames and covers.
- 1.2 Environmental Compliance: Comply with applicable portions of local Environmental Agency regulations pertaining to sanitary sewerage.
- 1.3 Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage.

PART 2 - PRODUCTS

- 2.1 Pipe and Fittings: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- 2.2 PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for solvent cement or elastomeric gasket joints.
 - A. Solvent Cement: ASTM D 2564.
 - B. Gaskets: ASTM F 477, elastomeric seal.
- 2.3 Dissimilar-Pipe Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.
 - A. Sleeves: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
 - B. Bands: Stainless steel, one at each pipe insert.
- 2.4 Dissimilar-Pipe Reducer Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
 - A. Gaskets: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
- 2.5 Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
 - A. Base Section: 6-inches minimum thickness for floor slab and 4-inches minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 - B. Riser Sections: 4-inches minimum thickness; 48-inches diameter and lengths to provide depth indicated.
 - C. Top Section: Eccentric cone type, unless concentric cone or flat slab top type is indicated. Top of cone to match grade rings.

- D. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inches diameter frame and cover.
- E. Gaskets: ASTM C 443, rubber.
- F. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- G. Channel and Bench: Concrete.
- 2.6 Cast-in-Place Manholes: Reinforced concrete of dimensions and with appurtenances indicated.
 - A. Bottom, Walls, and Top: Reinforced concrete.
 - B. Channel and Bench: Concrete.
- 2.7 Concrete: Portland cement mix, 3,000 psi.
 - A. Cement: ASTM C 150, Type II.
 - B. Fine Aggregate: ASTM C 33, sand.
 - C. Coarse Aggregate: ASTM C 33, crushed gravel.
 - D. Water: Potable.
- 2.8 Reinforcement: Steel conforming to the following:
 - A. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- 2.9 Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy-duty, ductile-iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter cover, indented top design, with lettering "SANITARY SEWER" cast into cover.
- 2.10 Cleanouts: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast iron access frame and heavy duty, secured, scoriated cast iron cover.
- 2.11 Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid green in color with continuously-printed caption in black letters "CAUTION SEWER LINE BURIED BELOW."

PART 3 - EXECUTION

- 3.1 Prepare Foundation for Buried Sanitary Sewerage Piping as Follows:
 - A. Grade trench bottom to provide a smooth, firm, stable, and rock free foundation, 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 level.
 - C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.
- 3.2 Install piping 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 gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- 3.3 Use manholes for changes in direction.
- 3.4 Reduction of the size of piping in the direction of flow is prohibited

- 3.6 3.5 Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
- 3.6 Extend sanitary sewerage piping to connect to building sanitary drains, of sizes and in locations indicated.
- 3.7 Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- 3.8 Join and install PVC Pipe as follows:
 - A. Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402.
 - B. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
 - C. Installation in accordance with ASTM D 2321.
- 3.9 Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.
- 3.10 Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- 3.11 Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- 3.12 Construct cast-in-place manholes as indicated.
- 3.13 Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- 3.14 Apply bituminous mastic coating at joints of sections.
- 3.15 Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade, or flush with grade when installed in paving.
- 3.16 Make connections to existing piping and underground structures, so that finished work will conform as nearly as practicable to the requirements specified for new work.
- 3.17 Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material which may accumulate.
- 3.18 Abandoned Piping: Close open ends of abandoned underground piping which is indicated to remain in place. Provide sufficiently strong closures to withstand hydro-static or earth pressure which may result after ends of abandoned utilities have been closed.
 - A. Close open ends of concrete or masonry utilities with not less than 8-inch thick brick masonry bulkheads.
 - B. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.

- 3.19 Abandoned Structures: Remove structure and close open ends of the remaining piping; or remove top of structure down to not less than 3 feet below final grade, fill structure with stone, ruble, gravel, or compacted dirt, to within 1 foot of top of structure remaining, and fill with concrete.
- 3.20 Testing: Perform testing of completed piping in accordance with TCEQ requirements.
- 3.21 Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - A. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - B. Flush piping between manholes, if required by local authority, to remove collected debris.
- 3.22 Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - A. Make inspections after pipe between manholes, and manhole locations, has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 - B. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and reinspect.

END OF SECTION 33 3000

SECTION 33 3010

WASTEWATER DUPLEX LIFT STATION PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The equipment manufacturer shall furnish for installation one complete factory built duplex wet well lift station including all equipment necessary for operation in accordance with the Contract Drawings and Specifications stated herein.
- B. The lift station shall have a firm capacity of 80 gpm.
- C. The lift station shall be comprised of the following components:
 - a.One (1) wet well
 - b.Two (2) Submersible non-clog type pumps in parallel
 - c.Control Panel
 - d.Level Controls
 - e.Piping and valves
 - f. Alarm system

1.2 RELATED WORK

A. Refer to owner's general conditions and special conditions

1.3 SUBMITTALS

- A. Complete assembly, foundation support, foundation subgrade, and installation drawings, together with detailed specifications and data covering pumps, motors, materials used, parts, devices and other accessories forming a part of the equipment furnished shall be submitted for approval.
- B. The submittal data and drawings shall include:
 - 1. Setting plans showing outline dimensions and weights of pumps, bases, motors, and control enclosures.
 - 2. Pump Manufacturer, Pump type and model number
 - 3. Assembly drawing, nomenclature and material list, O & M manual, and parts list.
 - 4. Impeller type, diameter, through-let dimensions, sphere size, number of vanes and identification number.
 - 5. Complete motor performance data
 - 6. Complete performance test curves showing full range head vs. capacity, NPSH required and hydraulic efficiency
 - 7. Complete list of materials used for construction.
 - 8. Complete List of Spare Parts
- C. This submittal shall include all the necessary information and shall not be limited to the following:
 - 1. Performance data as specified below and curves, and horsepower requirements.
 - 2. Functional description of any internal instrumentation and control supplied including list of parameters monitored, controlled, or alarmed.
 - 3. Provide contact information (name, address and phone number) of nearest service centers and a listing of the Manufacturer's representative's services available at these locations, including contact details of the nearest parts warehouses capable of providing full parts replacement and/or repair services.
 - 4. The pump manufacturer shall have to provide address of an authorized service center capable of completely servicing the proposed pumps within 100 miles of the project site. The pump manufacturer shall have a direct factory service center/stocking facility capable of servicing and which stocks identical complete drive units to and spare parts for, the proposed pumps within 100 miles of the project site.
 - 5. Manufacturer's Warranty.
- D. Partial or incomplete submittals will not be reviewed by the Engineer

1.4 QUALITY ASSURANCE

- A. All components shall be furnished by a single Manufacturer who is fully experienced, reputable, and qualified in the design and manufacture of duplex wet well lift station of similar size and capacity, and shall present proof of successful operations involving each piece of equipment furnished.
- B. The pumps shall be suitable for pumping raw sewage and shall be designed and fully guaranteed for this use.
- C. All pump performance documentation, including flow/head curves, shall adhere to the Hydraulic Institute Standards and shall allow no negative tolerance on flow, head, hydraulic efficiency or any other criteria deemed by the engineer to be necessary to evaluate pumping system performance.
- D. The Manufacturer shall inspect components of the system after installation as required to identify and correct any defects.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers:
 - a. Homa
 - b. Approved Equal

2.2 WET WELL

- A. The wet well shall be constructed of watertight glass fiber-reinforced polyester suitable for use in sanitary sewer applications. The resulting reinforced plastic material shall meet stiffness requirements as per ASTM Standard D3753. Wet well constructed of reinforced concrete is acceptable. Contractor shall provide complete design of concrete wet well to engineer and TPWD for approval
- B. The fiber-reinforced polyester wet well shall be 4-feet in diameter (inside of wall) and 8-feet deep.
- C. Provide passive ventilation pipe for wet well to include screening to prevent the entry of birds and insects to the wet well.
- D. Provide 2" NPT stubout from side of wet-well for future odor-control connection.
- E. The wet well floor shall have a smooth finish and design of wet well shall prevent deposition of solids under normal operating conditions.
- F. All pipe penetrations into the wet well shall be watertight. Seal all penetrations.
- G. The wet well shall have a lockable cover with aluminum or cast-iron access hatch. Access hatch shall have a safety cable harness attached.
- H. Wet well and cover with access hatch shall be grounded.
- Wet well shall have a jib crane mount in lieu of a rail system. Jib crane shall be the same manufacturer and model of the existing jib crane at the state park. Jib crane shall fit a 3-inch davit.
- J. Wet well and pumps shall be fed by single phase electrical power and be connected and operational with building backup generator.

2.3 LIFT STATION PUMPS AND MOTORS

- A. The raw wastewater pump shall conform to the following specifications:
 - 1. The pumps shall be solids handling non-clog type, capable of handling raw and unscreened sewer and passing solids through a 2-inch diameter force main.
 - 2. Pumps shall have the following characteristics and meet the following service conditions:

Submersible Pumps

Flow @ rated point 80 gpm
TDH @ rated point 8.05 ft

Rated Pump Speed 3,450 rpm

Motor Size 2.4 hp

Motor Voltage 230v/ single phase

Discharge Size 2-inch

- 3. Casings shall be gray cast iron, ASTM A-48, Class 35B. Casing bolts and nuts shall be AISI type 316 stainless steel.
- All submerged surfaces or surfaces contacting raw sewage shall be stainless steel, brass of factory applied corrosion resistant coated suitable for a raw sewage submerged environment.
- 5. Casing Seals: All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces, resulting in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit to effect this. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices shall be used.
- 6. Bearings: The pump shaft shall rotate on two permanently lubricated ball or roller bearings. Bearing shall have a minimum L-10 life of 20,000 hours, at continuous maximum load and speed. The shaft shall be of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all operating speeds.
- 7. Cables: Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. All cables shall be connected to the pumps and tested at the factory. The cable entry seal shall consist of a single elastomer grommet with washers located on either side. A compression fit of the grommet seals the cable and entry from the exterior fluid. The cable entry assembly shall allow easy replacement of cable by using the same cable entry grommet.
- 8. Pump Shaft Seal: Each pump shall have two mechanical seals, mounted in tandem, each operating independently of the other. The seals shall be hydro-dynamically lubricated with a buffer chamber between the seals. The lower seal shall be replaceable without disassembly of the seal chamber and without the use of special tools. Pump-out vanes shall be present on the backside of the impeller to keep contaminates out of the seal area. Seals shall be locally available.
- 9. Chopper Impeller: The impeller shall be gray cast iron class 35B, dynamically balanced, semi-open, multi vane, backswept non-clog capable of handling solids, fibrous material and sludge.
- 10. Each pump motor shall be cooled by the surrounding environment and pumped fluid. Cooling system must allow up to 15 motor starts per hour. The pump motor shall be suitable for continuous operation under submerged, partially submerged, or dry conditions.
- 11. Each pump, including the motor and wiring, shall be approved by a nationally-approved testing agency for submersible service. The system shall be rated Class 1, Division 1, Group C and D, service as determined by the National Electric Code and approved by a nationally-recognized testing agency (UL or FM) at the time of bidding of the project.
- 12. Motors shall be rated for explosion proof service and to pump continuously in a non-submerged condition at an ambient temperature of 105° F.
- 13. One pump shall be equipped with an automatically operating mixing valve mounted directly on the pump volute. The automatic valve shall be actuated through a self-contained hydraulic system and operated by differential pressure across the valve. The valve shall not require any external power source or control to operate.

2.4 LIFT STATION PIPES AND VALVES

- A. All pipes in the station shall be minimum ductile iron pipe or schedule 80 PVC
- B. The lift station pipes shall have flanged or flexible connections to allow for removal of pumps and valves without interruption of the lift station operations.
- C. Each pump shall have a separate suction pipe that uses an eccentric reducer.
- D. All wiring shall be in rigid conduit or seal tight flexible conduit and shall be in accordance with the National Electric Code.

2.5 RAIL SYSTEM

A. The pumps shall be freestanding not have a rail system for access to the wet well. Wet well will shall have a Jib crane mount for placement and removal.

2.6 PUMP CONTROLS

- A. The pump system shall be provided with a local control panel. Local control panels shall be freestanding, pedestal mounted, with NEMA 4X stainless steel enclosure ratings.
- B. Local control panels shall house controls and wiring for drive units, motor starters, transformers, circuit breakers, voltage barriers, panel-mounted devices, relays, terminal strips, alternator controls, and other appurtenances as necessary for each motor. Power feed to local control panels shall be 240V AC, single-phase, 60 Hz. Identified terminal strips shall be provided for the connection of external conductors to equipment-mounted junction boxes. All equipment shall be shipped from the factory ready for service after connection of conductors to equipment, controls, and local control panels. Provide high-level alarm relay with panel contact and top-mounted weather-proof alarm light, 100 watt bulb, red globe with guard. Provide condensate protection with heater and adjustable thermostat.
- C. Each local control panel shall be provided with a local/off/automatic (LOA) selector switch, and start and stop push buttons. When the LOA switch is placed in the "local" position, the pump shall start and stop when its local start and stop push buttons are engaged. When the LOA switch is placed in the "off" position, the pump shall not operate. When the LOA switch is placed in the "automatic" position, the pumps shall be start and stop based on the level sensors.
- D. The lift station shall have electrical control panel in combination with four (4) liquid level sensors.
- E. Level sensors shall be mercury switches encapsulated in a polypropylene float with exterior weight or the tie down straps on the float cable as required.

2.7 EMERGENCY PROVISIONS

- 1. The lift station shall include an audiovisual alarm system and the alarm system shall transmit all alarm conditions through use of a supervisory control and data acquisition (SCADA) system to a continuously monitored location.
- 2. The alarm shall self-activate for a power outage, pump failure or a high wet well water level. Alarm shall have a backup power supply located within the control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. When the lift station is completely installed, electrical connections completed, and all equipment ready for service, the equipment manufacturer shall provide the service of a qualified representative to start-up the equipment and instruct the operator in the proper operation and maintenance of the system. The manufacturers shall turn over to the operator at this time the operating and maintenance manual.

3.2 MANUFACTURER'S WARRANTY

A. The Pump Manufacturer shall warrant to the original purchaser all new equipment manufactured by it to be free of defects in material and workmanship. In the event a component fails to perform under normal use or is proven defective in service, the Manufacturer shall repair or replace, at his discretion, such defective part within two (2) years following substantial completion. He shall further provide, without cost, such labor as may be required to replace, repair or modify major components. The repair and maintenance of items normally consumed in service such as seals, grease, light bulbs etc. shall be considered as part of routine maintenance and upkeep. It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

END OF SECTION 33 3010

SECTION 33 4000

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

- 1.1 BASE SPECIFICATION
 - A. Reference Specification for Storm Sewerage and related products shall be the "Texas Standard Specifications", latest edition as published by Texas Department of Transportation (TxDOT).
- 1.2 Submittals: Submit the following:
 - A. Product data for drainage piping specialties.
 - B. Shop drawings for precast concrete storm drainage manholes and catch basins, including frames, covers, and grates.
 - C. Shop drawings for cast-in-place concrete or field erected masonry storm drainage manholes and catch basins, including frames and covers.
- 1.3 Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for rubber gasket joints.
 - A. Gaskets: ASTM C 443, rubber.
- 1.4 Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
 - A. Base Section: 6-inches minimum thickness for floor slab and 4-inches minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 - B. Riser Sections: 4-inches minimum thickness; 48-inches diameter and lengths to provide depth indicated.
 - C. Top Section: Eccentric cone type, unless concentric cone or flat slab top type is indicated. Top of cone to match grade rings.
 - D. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inch diameter frame and cover.
 - E. Gaskets: ASTM C 443, rubber.
 - F. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - G. Channel and Bench: Concrete.
- 1.5 Cast-in-Place Manholes: Reinforced concrete of dimensions and with appurtenances indicated.
 - A. Bottom, Walls, and Top: Reinforced concrete.
 - B. Channel and Bench: Concrete.
- 1.6 Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy-duty, ductile-iron, 24-inch inside diameter by 7 to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter cover, indented top design, with lettering "STORM SEWER" cast into cover.
- 1.7 Precast Concrete Catch Basins: ASTM C 478 or ASTM C 858, precast reinforced concrete, of depth indicated. Sections shall have provision for rubber gasket joints. Base section slab shall have minimum thickness of 6 inches, riser sections shall have minimum thickness of 4 inches and be 48 inches inside diameter, and top section and grade rings shall match 24-inch frame and grate, unless otherwise indicated.
 - A. Base Section: Base riser section and separate base slab, or base riser section with integral floor.
 - B. Riser Sections: Sections shall be of lengths to provide depth indicated.
 - C. Top Section: Flat slab type with opening to match grade rings.
 - D. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness.
 - E. Gaskets: ASTM C 443, rubber.

- F. Steps: Cast into riser sidewall at 12 to 16-inch intervals.
- G. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- H. Channel and Bench: Concrete.
- 1.8 Cast-in-Place Catch Basins: Reinforced concrete of dimensions and with appurtenances indicated.
 - A. Bottom, Walls, and Top: Reinforced concrete.
 - B. Channel and Bench: Concrete.
- 1.9 Catch Basin Frames and Grates: ASTM A 536 Grade 60-40-18, heavy-duty, ductile-iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter flat grate having small square or short slotted drainage openings.
- 1.10 Curb Inlets: Precast concrete, brick, or other materials, and of dimensions conforming to utility standards.
- 1.11 Outfalls: Construct of cast-in-place reinforced concrete with pipe, head wall, apron, tapered sides, and with rip rap, as indicated.
 - A. Rip Rap: Broken stone, irregular size and shape, weighing 15 to 50 pounds each.
- 1.12 Concrete: Portland cement mix, 3,000 psi.
 - A. Cement: ASTM C 150, Type II.
 - B. Fine Aggregate: ASTM C 33, sand.
 - C. Coarse Aggregate: ASTM C 33, crushed gravel.
 - D. Water: Potable.
- 1.13 Reinforcement: Steel conforming to the following:
 - A. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

PART 2 - EXECUTION

- 2.1 Prepare Foundation for Buried Storm Sewerage Piping as Follows:
 - A. Grade trench bottom to provide a smooth, firm, stable, and rock free foundation, 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 level.
 - C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.
 - D. Install crushed stone bedding per detail on Sheet C403.
- 2.2 Install piping 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 gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- 2.3 Use manholes or catch basins for changes in direction.
- 2.4 Reduction of the size of piping in the direction of flow is prohibited.
- 2.5 Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- 2.6 Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.

- 2.7 Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- 2.8 Join concrete pipe and fittings with rubber gaskets in accordance with ASTM C 443 and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual."
- 2.9 Joint wrapping: Each joint of pipe is to be wrapped with Mirafi fabric.
- 2.10 Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- 2.11 Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- 2.12 Construct cast-in-place manholes as indicated.
- 2.13 Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- 2.14 Apply bituminous mastic coating at joints of sections.
- 2.15 Construct catch basins to sizes and shapes indicated.
- 2.16 Set frames and grates to elevations indicated.
- 2.17 Construct outfalls of reinforced concrete which will attain 28-day compressive strength of not less than 3000 psi.
- 2.18 Testing: Perform testing of completed piping in accordance with TCEQ requirements.
- 2.19 Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - A. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - B. Flush piping between manholes, if required by local authority, to remove collected debris.
- 2.20 Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - A. Make inspections after pipe between manholes, and manhole locations, has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 - B. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and reinspect.

END OF SECTION 33 4000