

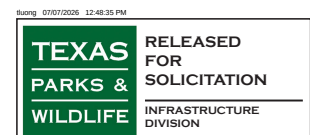
PROJECT MANUAL

Texas Parks & Wildlife TPWD Powderhorn WMA New Conservation Education Center Project #1210264 Port O'Connor, Texas

PROJECT MANUAL
May 22, 2026

CONTENT INCLUDED:
Technical Specifications

Prepared by:
Richter Associates

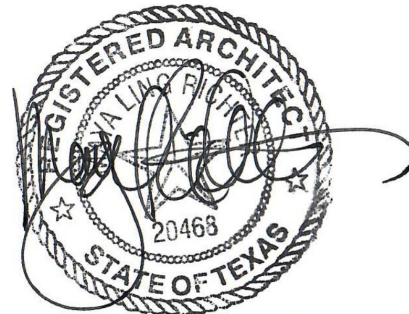


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1.1 DESIGN PROFESSIONALS OF RECORD

A. ARCHITECT:

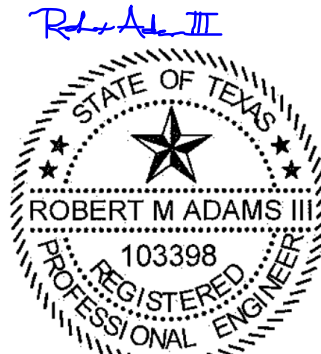
1. Maya Richter Hernandez, AIA
RICHTER ASSOCIATES
201 S. Upper Broadway
Corpus Christi, Texas 78403
2. Texas Architectural Registration No. 7113
3. Responsible for Divisions 00-34 Sections; except where indicated as prepared by other design professionals of record.



05.22.26

B. STRUCTURAL ENGINEER:

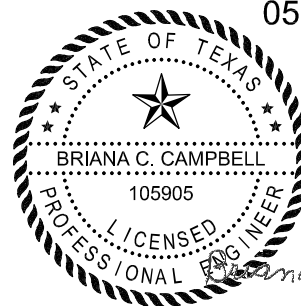
1. Robert Adams
IMEG Corporation
11044 Research Blvd.
Building A, Suite 230
Austin, Texas 78759
2. Texas Professional Engineer # 103398
3. Responsible for Divisions
 - a. 03 10 00 – Concrete Formwork
 - b. 03 20 00 – Concrete Reinforcement
 - c. 03 30 00 – Cast in Place Concrete
 - d. 13 34 19 – Metal Building Systems
 - e. 31 23 00 – Foundation Excavating



5 / 22 / 2026

C. CIVIL ENGINEER:

1. Briana Campbell, PE
JQ Infrastructure, LLC
15810 Park Ten Place, Ste. 225
Houston, TX 77084
Texas Professional Engineer No. 105905
Responsible for Divisions 31-33



05.22.2026

D. PLUMBING ENGINEER:

1. Sean Rodriguez, PE
NRG Engineering
5656 S. Staples, Ste. 312
Corpus Christi, Tx 78411
Texas Professional Engineer No. 96478
Responsible for Division 22



E. MECHANICAL ENGINEER:

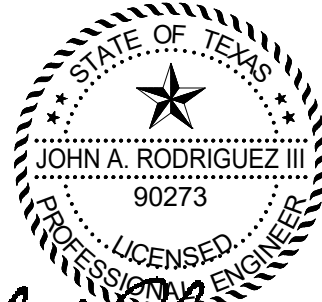
1. Sean Rodriguez, PE
NRG Engineering
5656 Staples, Ste. 312
Corpus Christi, Tx 78411
Texas Professional Engineer No. 96478
Responsible for Division 23



05/22/2026

F. ELECTRICAL ENGINEER:

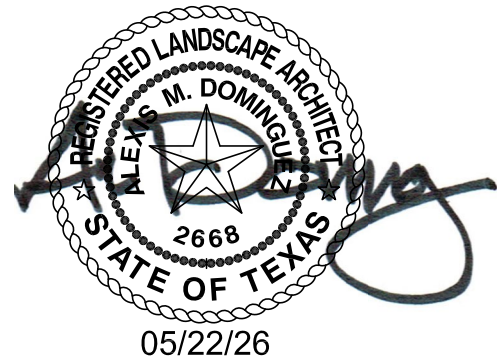
1. John Rodriguez, III, PE
NRG Engineering
5656 Staples, Ste. 312
Corpus Christi, Tx 78411
Texas Professional Engineer No. 90273
Responsible for Division 26



G. LANDSCAPE ARCHITECT

1. Alex M. Dominguez, Landscape Architect. 05/22/2026
ADLA LANDSCAPE ARCHITECTURE, INC.
4833 Saratoga Blvd. #116
Corpus Christi, Texas 78413
2. Texas Landscape Architect No. 2668
3. Responsible for Division 32

John A. Rodriguez III



05/22/26

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PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor acknowledges to and for the benefit of the Owner (“Purchaser”) that it understands the goods and services under this Agreement are being funded with federal monies that have statutory requirements commonly known as “Build America, Buy America;” that requires all of the iron and steel, manufactured products, and construction materials used in the project to be produced in the United States (“Build America, Buy America Requirements”) including iron and steel, manufactured products, and construction materials provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner (a) the Contractor has reviewed and understands the Build America, Buy America Requirements, (b) all of the iron and steel, manufactured products, and construction materials used in the project will be and/or have been produced in the United States in a manner that complies with the Build America, Buy America Requirements, unless a waiver of the Requirements is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Build America, Buy America Requirements, as may be requested by the Owner.

1.2 TECHNICAL SPECIFICATIONS

- A. The language above shall supersede any conflicting provision explicitly or implicitly included in any technical specification applicable to the project, including any reference to basis of design manufacturers or products. For every application, submittals including manufacturers or products not compliant with “Build America, Buy America” requirements shall be rejected as noncompliant.

END OF SECTION 00 90 01

SECTION 01 10 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and other Division 00 & 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Owner-furnished products.
 - 3. Use of premises.
 - 4. Related Sections include the following:
- B. Division 1, General Requirements for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: POWDERHORN WILDLIFE MANGEMENT AREA.
 - 1. Project Location: Calhoun County, Texas.
- B. Owner: Texas Parks and Wildlife
- C. The Work consists of the following:
 - 1. General: The new facility will feature multi-purpose indoor spaces, administrative offices, and a covered outdoor game processing area, promoting conservation, public education, and responsible recreation. Designed for coastal resilience, it will utilize hurricane-resistant, low-maintenance materials and corrosion-resistant construction.

1.4 USE OF PREMISES

- A. General: Contractor shall have use of the areas indicated for construction use by the contractor, as indicated in the construction documents.

1.5 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "MasterFormat®2012" numbering system.
 - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 - 2. Division 00: Sections in Division 00 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in specific situations. These conventions are as follows:
 - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicated whether alternates have been accepted, rejected or deferred for later consideration. Include a description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Both the Base Bid and any accepted alternate shall be complete and finished structures with any necessary building component or system required for reasonable functionality. Base Bid shall include work indicated on the Construction Documents (not specifically indicated as a Bid Alternate) required providing a total and complete product implied by the overall project scope.

1. **Bid Alternate No. One (1):**

If Bid Alternate No. One (1) is accepted by the Owner, the Contractor shall furnish, provide, and install all labor, materials, equipment, and services necessary for the complete construction of the North Porch. The Work shall include, at a minimum, site preparation, all concrete including foundations, structural steel columns and joists, roofing and flashing, galvanized steel purlins, and gutters and downspouts, all in accordance with the Contract Documents and applicable codes.

2. END OF SECTION 01 23 00

SECTION 03 35 43 – POLISHED CONCRETE FLOOR FINISHING

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: Mechanically polished concrete.
- B. Related Sections:
 - 1. Section 03 30 00 "Cast-In-Place Concrete."
- C. Contractor Protection of floor areas to received polished concrete finish:
 - 1. It shall be the sole responsibility of the general contractor to provided temporary surface protection for those floor areas scheduled to receive a polished concrete finish during the course of construction in preparation for the concrete finishing process.
 - 2. The contractor shall provide temporary protective floor coverings to protect the concrete floor surfaces from chemical and or oil contamination & physical surface damage due to impact and/or abrasion.
 - 3. Temporary coverings shall be properly & effectively secured in place to prevent removal or adjustment utilizing non-mechanical fastening means only. Refer also to Article 1.09, Paragraph C.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 302.1R Guide for Concrete Floor and Slab Construction.
 - 2. International Polished Concrete Institute
- B. ASTM International:
 - 1. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete.

3. ASTM C779 Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide polished flooring that has been selected, manufactured and installed to achieve the following:
 1. Abrasion Resistance: ASTM C779, Method A, high resistance, no more than 0.008-inch wear in 30 minutes.
 2. Reflectivity: Increase of 35% as determined by standard gloss meter.
 3. Waterproof Properties: Rilem Test Method 11.4, 70% or greater reduction in absorption.
 4. High Traction Rating: NFSI 101-A, ANSI B-101.1 2009, non-slip properties.
- B. Design Requirements:
 1. Hardened Concrete Properties:
 - a. Minimum Concrete Compressive Strength: 3500 psi (24 MPa).
 - b. Normal Weight Concrete: No lightweight aggregate.
 - c. Non-air entrained.
 2. Placement Properties:
 - a. Natural concrete slump of 4 1/2 inches - 5 inches. Admixtures may be used.
 - b. Flatness Requirements:
 - 1) Overall FF 40.
 - 2) Local FF 20.
- C. Hard-Steel Troweled Concrete: No burn marks. Finish to ACI 302.1R, Class 5 floor.
- D. Curing Options:
 1. Membrane forming curing compounds (ASTM C309, Type 1, Class B, all resin, dissipating cure).
 - a. Acrylic curing and sealing compounds NOT permitted.
 2. Sheet membrane (ASTM C171); polyethylene film not accepted.
 3. Damp Curing: Seven-day cure.

1.5 ACTION SUBMITTALS

- A. General: Submit listed action submittals in accordance with Contract Conditions and Section 01 33 00 - Submittal Procedures.

- B. Shop Drawings: Indicate information on shop drawings as follows:
 - 1. Typical layout including dimensions and floor grinding schedule.
 - 2. No joints permitted in concrete slab on this project.
 - 3. Hardener, sealer, densifier in notes.
- C. Product Data: Submit product data, including manufacturer's SPEC-DATA® product sheet, for specified products.
 - 1. Material Safety Data Sheets (MSDS).
 - 2. Preparation and concrete grinding procedures.
- D. Substitutions: Substitutions permitted per Section 01 25 00.

1.6 INFORMATION SUBMITTALS

- A. Quality Assurance:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties as cited in 1.03 Performance Requirements.
- B. Certificates:
 - 1. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - 2. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed phase Two Level of certification when tested by Method 101-A. ANSI B-101.1 2009 non-slip properties.
 - 3. Current contractor's certificate signed by manufacturer declaring contractor as an approved installer of polishing system.
- C. Manufacturer's Instructions: Manufacturer's installation instructions.

1.7 CLOSEOUT SUBMITTALS

- A. Warranty Submit warranty documents specified.
- B. Operation and Maintenance Data: Submit operation and maintenance data for installed products.
 - 1. Include:
 - a. Manufacturer's instructions on maintenance renewal of applied treatments.
 - b. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.8 QUALITY ASSURANCE

A. Qualifications:

1. Installer trained and holding current certification for manufacturers polished concrete system installation.
2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.

B. Regulatory Requirements.

1. NFSI Test Method 101-A Phase Two Level High Traction Material.

C. Mock-Ups:

1. Construct mock-ups in accordance with Section 01 40 00 - Quality Requirements.
2. Mock-Up Size: 100 ft² sample panel at jobsite at location as directed under conditions similar to those which will exist during actual placement.
3. Mock-up will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application, color selection and shine.
4. Allow 24 hours for inspection of mock-up before proceeding with work.
5. When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may not remain as part of finished work. Remove mock-up and dispose of materials when no longer required and when approved by the Architect.
6. Mock up will show specified level of aggregate exposure as:
7. Class B - Fine Aggregate (As required to achieve a uniform sheen.) Finish - Expose the fine aggregate such as sand and small aggregate with the concrete. The depth of grind will depend greatly on the placement and finishing procedures.
8. Mock up to show specified level of gloss level when concrete is mechanically processed as outlined in section 3.03 Installation.
 - a. Level 3 Sheen Highly polished (Sharp, crisp reflections, very high gloss) as determined by a gloss reading of 40 or higher (800 or higher grit).

D. Pre-installation Meetings: Conduct a pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:

1. Environmental requirements.
2. Scheduling and phasing of work.
3. Coordinating with other work and personnel.
4. Protection of adjacent surfaces.
5. Surface preparation.

6. Patch all voids and rough areas.
7. Repair of defects and defective work prior to installation.
8. Cleaning.
9. Installation of polished floor finishes.
10. Application of liquid hardener, densifier.
11. Protection of finished surfaces after installation.
12. Do not place any materials on the concrete surface that may cause staining, etching, or scratching.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery:
 1. Deliver materials in manufacturer's original packaging with identification labels and seals intact.
- C. Storage and Protection:
 1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 2. Protect concrete slab.
 - a. Protect from petroleum stains during construction.
 - b. Diaper hydraulic power equipment.
 - c. Restrict vehicular parking.
 - d. Restrict use of pipe cutting machinery.
 - e. Restrict placement of reinforcing steel on slab.
 - f. Restrict use of acids or acidic detergents on slab.
 - g. Waste Management and Disposal:
 3. Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.10 PROJECT AMBIENT CONDITIONS

- A. Installation Location: Comply with manufacturer's written recommendations.

1.11 SEQUENCING

- A. Sequence with Other Work: Comply with manufacturer's written recommendations for sequencing construction operations.

1.12 WARRANTY

- A. Project Warranty: Refer to Contract Conditions for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.
- C. Warranty: Commencing on approved date of substantial completion.

1.13 MAINTENANCE

- A. Comply with manufacturer's written instructions to maintain installed product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ensure manufacturer has minimum 5 years' experience in manufacturing components similar to or exceeding requirements of project.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Laticrete® L&M™ FGS Permashine concrete sealing system as manufactured by L & M Construction Chemicals, a brand of Laticrete International, Inc.; or an approved equal product by one of the following:
 - 1. Euclid Chemical Company (The); an RPM company.
 - 2. NewLook International, Inc.
 - 3. PROSOCO, Inc.
 - 4. Ameripolish
- C. Source Limitations: Obtain polished concrete finish products from single source. Ensure concrete finishing components and materials are from a single manufacturer.

2.2 SOURCE QUALITY CONTROL

- A. Source Limitations: Obtain polished concrete finish components and materials from a single source manufacturer.

2.3 POLISHED CONCRETE FINISHING PRODUCTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
- B. Polished Concrete Floor Finishing System:
 - 1. Hardener, Sealer, Densifier: Water based, odorless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., FGS Hardener Plus.
 - 2. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing, polyurea control joint and crack filler with Shore A 80 or higher hardness.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., Joint Tite 750.
 - 3. Oil Repellent Sealer: Ready to use, silane, siloxane and fluoropolymers blended water based solution sealer, quick drying, low-odor, oil and water repellent, VOC compliant and compatible with chemically hardened floors.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., Petrotex.
 - 4. Cleaning Solution: Mild, highly concentrated liquid concrete cleaner and conditioner containing wetting and emulsifying agents; biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI).
 - a. Acceptable Material: L & M Construction Chemicals, Inc., FGS Concrete Conditioner.
 - 5. Stain Guard Sealer: Ready to use, is a low odor, VOC compliant, topical sealer consisting of low molecular emulsified cross-linking, coupling polymers that effectively protect concrete and other natural stone floor surfaces from the damaging effects of staining, defacing and deterioration due to contaminant penetration.
 - a. Acceptable Material: L& M Construction Chemicals, Inc. Permaguard SPS.
 - 6. Finish: Standard 800 grit, very high gloss (VGH-3).
 - 7. Color: Natural concrete, no color dye.

PART 3 - EXECUTION

3.1 MANUFACTURERS INSTRUCTIONS

- A. Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions and L&M Construction Chemicals, Inc. Tech-DATA sheets.

3.2 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that concrete substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete finishing materials.
- B. Verify Concrete Slab Performance Requirements:
 - 1. Verify concrete is cured to 28-day 3500 psi strength.
 - 2. Verify concrete surfaces have received a hard steel-trowel finish (3 passes) during placement.

3.3 PREPARATION

- A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of concrete finishing materials. Clean existing concrete surfaces with cleaners approved by floor finish manufacturer. Do not proceed with grinding and finishing until surface is inspected and approved by floor finish manufacturer.
- B. Examine surface to determine soundness of concrete for polishing.
- C. General Contractor to remove surface contamination.

3.4 INSTALLATION

- A. Application: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and L & M Construction Chemicals, Inc., Tech-DATA sheets.
 - 1. Use only manufacturer's certified installers.
- B. Floor Surface Polishing and Treatment:

1. Provide polished concrete floor treatment to areas indicated on Drawings. Provide consistent finish in all contiguous areas.
2. Apply floor finish prior to installation of fixtures and accessories.
3. Polishing Level: Level 3: High sheen, 800 grit.
4. Diamond polish concrete floor surfaces with power disc machine recommended by floor finish manufacturer. Sequence with coarse to fine grit using dry method. Installer to determine the optimum starting grit in order to achieve the specified aggregate exposure.
 - a. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Following the initial passes of metal bond diamonds, the installer shall drop back a minimum of one grit level when transitioning to resin bond diamonds. The separation in grit designation shall be a minimum of 50 for the transitioning step. The installer shall refine each abrasive grit to its fullest potential before moving on to the next level. Floor shall be thoroughly scrubbed between each grit pass to remove all loose material. Level of sheen shall match that of approved mock-up.
 - b. Expose aggregate in concrete surface only as determined by approved mock-up.
 - c. All concrete surfaces shall be as uniform in appearance as possible.
5. Fill joints flush to surface, with joint filler, per manufacturer's recommendations prior to the start of polishing operations.
6. Apply two coats of FGS Hardener Plus, Hardener, Densifier as follows:
 - a. First coat of FGS Hardener Plus at 250 ft²/gal (6.25 m²/L), following the 400 grit level.
 - b. Second coat of FGS Hardener Plus at 350 ft²/gal (8.75 m²/L), prior to the final polishing pass.
7. Remove defects and re-polish areas.
8. Finish edges of floor finish adjoining other materials in a clean and sharp manner.
9. Finish Level: Very High Gloss, VHG-3 for all areas indicated to receive Polished Concrete Floor Finishing System.

3.5 ADJUSTMENTS

- A. Re-polish those areas not meeting specified gloss levels per mock-up.
- B. Fill joints flush to surface prior to the start of polishing operations.

3.6 FINAL CLEANING

- A. Mechanically scrub treated floors for seven days with soft to medium pads with approved cleaning solution.

- B. Remove surplus and excess materials, rubbish, tools and equipment.

3.7 PROTECTION

- A. Protect installed product from damage up to approved date of Substantial Completion.

END OF SECTION 03 35 43

SECTION 05 40 00 - COLD-FORMED METAL 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. This Section includes the following:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Suspension systems for gypsum ceilings, soffits, and grid systems.
 - 3. Ceiling joist framing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" for gypsum board products attached to wall framing.

1.3 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Provide TDI windstorm pressures per section 01 33 00 – Submittal Requirements.
- C. Shop Drawings: Provide shop drawings prepared by cold-formed metal framing manufacturer. Show layout, spacing, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Welded connections shall show size and length of welds for all connections.
 - 3. Connections / Fasteners 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces

- (ASTM A899) Screwed connections shall show type, size, and number of screws for all connections. Submit manufacturer's data giving strength values for screws used.
4. Connections using anchors shall show product name, embedment, edge distance and spacing.
- D. Calculations: Submit calculations for all cold-formed metal that are prepared and sealed by a professional engineer licensed in the state where the project is located. Calculations shall indicate sizing of members supporting the loads as indicated on the drawings and the design of connections indicating method of connection and:
1. Size and length of all welds for welded connections.
 2. Type, size, number and capacity of all screwed connections.
- E. Welding certificates.
- F. Qualification Data: For professional engineer.
- G. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Vertical deflection clips.
 6. Horizontal drift deflection clips
 7. Miscellaneous structural clips and accessories.
- H. Research/Evaluation Reports: For cold-formed metal framing.
1. Metal stud manufacturer to have a third party evaluation report for its products that are reviewed to the local building code or its model code IBC 2015 and AISI S100.

1.4 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those

performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

- C. Testing Agency Qualifications: Manufacturer's material certification or data from a independent testing agency that is qualified according to ASTM E329 indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
1. AllSteel Products, Inc.
 2. California Expanded Metal Products Company.
 3. ClarkDietrich Building Systems.
 4. Consolidated Fabricators Corp.; Building Products Division.
 5. Craco Metals Manufacturing, LLC.
 6. Custom Stud, Inc.
 7. Formetal Co. Inc. (The).
 8. Innovative Steel Systems.
 9. MarinoWare; a division of Ware Industries.
 10. Quail Run Building Materials, Inc.
 11. SCAFCO Corporation.
 12. Steel Construction Systems.
 13. Steeler, Inc.
 14. Super Stud Building Products, Inc.
 15. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on structural drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Wall Framing: Horizontal deflection of 1/600 of the wall height.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 psf.
 - c. Floor Joist Framing: Vertical deflection of 1/480 for live loads and 1/360 for total loads of the span.
 - d. Roof Rafter Framing: Horizontal deflection of 1/360 of the horizontally projected span.
 - e. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.
 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on

fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: As required by structural performance.
 2. Coating: G90 (Z275).
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: 340, Class 1 or 2.
 2. Coating: G90 (Z275).

2.4 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Steel studs of size and thickness as required by structural performance or as indicated, with minimum dimensions as follows.
 2. Minimum Base-Metal Thickness: .0538 inches.
 3. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Standard tracks of size, shape, and thickness as required by structural performance or as indicated, with a minimum flange width of 1-1/4" inches with no return flange lip.
 2. Minimum Base-Metal Thickness: .0428 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Steel studs of size and thickness as required by structural performance or as indicated, with minimum dimensions as follows.
 2. Minimum Base-Metal Thickness: 0.0428 inches.
 3. Flange Width: 1-5/8 inches.
- D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Steel studs of size and thickness as required by structural performance or as indicated, with minimum dimensions as follows.
 2. Minimum Base-Metal Thickness: 0.0428 inches.
 3. Top Flange Width: 1-5/8 inches.
- E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track, including "angled or pitched" track where necessary; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Metal Framing: ClarkDietrich Building Systems; MaxTrak or BlazeFrame Slotted Deflection Track.
 - b. MBA Building Supplies; Slotted Deflection Track.
 - c. Steel Network Inc. (The); VertiTrack VTD Series.
 - d. Or approved equal.
 2. Minimum Base-Metal Thickness: 0.0538 inches.
 3. Flange Width: 1 inch plus the design gap for 1-story structures.

- F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems; MaxTrak or BlazeFrame Firestop Track.
 - b. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - c. Metal-Lite, Inc.; The System.
 - d. Or approved equal.
- G. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm), unless otherwise indicated on the Drawings.
 - 2. Depth: As indicated on Drawings.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Steel studs of size and thickness as required by structural performance or as indicated, with minimum dimensions as follows.
 - 2. Minimum Base-Metal Thickness: 0.0428 inches.
 - 3. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inches.
 - 2. Flange Width: 1-1/4" inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.
 - e. Or approved equal.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track, including "angled or pitched" track where necessary; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich Building Systems; MaxTrak or BlazeFrame Slotted Deflection Track.
 - b. MBA Building Supplies; Slotted Deflection Track.
 - c. Steel Network Inc. (The); VertiTrack VTD Series.
 - d. Or approved equal.
 3. Minimum Base-Metal Thickness: 0.0538 inches.
 4. Flange Width: 1 inch plus the design gap for 1-story structures.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inches.
 - b. Flange Width: 1 inch plus the design gap for 1-story structures.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inches.
 - b. Flange Width equal to sum of outer deflection track flange width plus 1 inch.

- F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. ClarkDietrich Building Systems; MaxTrak or BlazeFrame Firestop Track.
 - c. Metal-Lite, Inc.; The System.
 - d. Or approved equal.
- G. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.
- H. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
- J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.6 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Steel studs of size and thickness as required by structural performance, or as indicated, with minimum dimensions as follows.
 - 2. Minimum Base-Metal Thickness: 0.0428 inches.
 - 3. Flange Width: 2 inches, minimum.

2.7 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Steel studs of size and thickness as required by structural performance, or as indicated, with minimum dimensions as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inch.
 - b. Flange Width: 2 inches, minimum.

2.8 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers, knee braces, and girts.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.9 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899) ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899) Fabricated

from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

- D. Power-Actuated Anchors: 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899) Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899) ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.10 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.11 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.
 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1:960 and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according ASTM C 1007 and AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 5/8 inches.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1:960 and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches on center.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 - 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 305 mm of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at 96-inch centers.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs.

Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

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

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

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 framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and support are not specified in other Sections.
3. Lintel angles.
4. Steel framing, door sill angles, and incidental steel components.
5. Skinning racks.
6. Trench drain grates

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 05 12 00 "Structural Steel."
3. Section 08 11 13 "Hollow Metal Doors and Frames" for coordination of installation of anchoring angles.

1.3 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 metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing, door sill angles, and incidental steel components.
 - 2. Shelf angles.
 - 3. Miscellaneous steel angles at exterior door frames.
- C. Samples for Verification: For each type and finish of extruded nosing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop-primers, certifying that shop-primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified registered Professional Engineer, as defined in Section 01 40 00 "Quality Assurance & Control Requirements," to design framing and supports indicated herein.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Abrasive-Surface Floor Plate: Aluminum plate, ASTM B 26/B 26M, Alloy 443.0-F, with abrasive granules rolled into surface.
- F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.4 NON-FERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.5 FASTENERS

- A. General: Unless specifically otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at interior applications. Select fasteners for type, grade, and class required.
- B. Hot dipped galvanized Bolts and Nuts: Regular hexagon-head annealed bolts, nuts and, where indicated, flat washers; for bolts and for nuts.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip galvanized, where item being fastened is indicated to be galvanized.
- D. Eyebolts: ASTM A 489.
- E. Wood Screws: Flat head, ASME B18.6.1.
- F. Plain Washers: Round.
- G. Lock Washers: Helical, spring type.

- H. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47 M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- I. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Hot-dipped galvanized or stainless-steel bolts and nuts.
- J. Material for Anchors in Exterior Locations: Hot-dipped galvanized or stainless-steel bolts and nuts.
- K. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- L. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M) Retain "Slotted-Channel Inserts" Paragraph below if required for supporting elevator guide rails or other items on masonry or concrete walls.
- M. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. ICI Devco Coatings; Catha-Coat 313.
 - c. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
 - d. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
- D. Galvanizing Repair – See below paragraph.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of, unless otherwise indicated.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, with a minimum embedment and hook, not less than from ends and corners of units and o.c., unless otherwise indicated.

2.8 METAL BOLLARDS

- A. Fabricate metal bollards from 1/4-inch wall-thickness rectangular steel tubing steel shapes, and hot dipped galvanize.
 1. Where indicated on drawings, fill with concrete.
 2. Where indicated on drawings, cap bollards with 1/4-inch-thick steel plate.
 3. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 4. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Set bollard in concrete as indicated in drawings.
- C. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent

construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts if units are installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

Galvanize miscellaneous framing and supports where indicated.

2.10 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Hot-dip galvanized plates after fabrication at exterior applications only.
- C. Prime plates with zinc-rich primer at interior locations only.

2.11 STEEL WELD PLATES AND ANGLES

Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 STEEL SKINNING RACKS

1. Provide animal skinning racks complete with posts, winch attachment plates, base plates, anchors, and fasteners.
2. Materials:
 - Structural Tubing: 3" schedule 40 pipe columns and W8x13 beams, ASTM A500, Grade B or C. Assembly shall be hot dipped galvanized.
 - Plates: ASTM A36 steel.
 - Fasteners: Hot-dip galvanized high-strength bolts, nuts, and washers.
3. Configuration:
 - Overall Height: 13 feet.
 - Overall Width: 10 feet.
 - Construction: Modular, field-bolted sections.
 - Connections: Bolted only; no field welding permitted.
 - Base Plates: Steel base plates sized for imposed loads and drilled for anchor bolts.
 - Assembly shall be hot dipped galvanized.

4. Winch Attachment Plates:
 - Provide welded steel plates to receive winches as indicated on Drawings.
 - Plates shall be reinforced as required to support winch loads without deformation.
 - Assembly shall be hot dipped galvanized.
5. Fabrication:
 - Fabricate racks plumb and true.
 - Grind exposed welds smooth.
 - Clearly mark components for field reassembly.
 - Assembly shall be hot dipped galvanized.
6. Finish:
 - Hot-dip galvanize all rack components after fabrication in accordance with ASTM A123/A123M.
 - Repair damaged galvanizing in accordance with ASTM A780 using zinc solder method only.
7. Installation:
 - Install racks plumb, level, and securely anchored to concrete substrates.
 - Tighten bolts to manufacturer's recommended torque.

2.13 STEEL TROLLEY SUPPORT STRUCTRE (SEE STRUCTURAL AND ARCHITECTURAL DRAWINGS)

8. Provide complete trolley support posts and beams, attachment plates, base plates, anchors, and fasteners.
9. Materials:
 - Structural Tubing Columns: 3" schedule 40 pipe columns and W8x13 beams, ASTM A500, Grade B or C. Assembly shall be hot dipped galvanized.
 - Structural Wide Flange Beams: W8x13
 - Plates: ASTM A36 steel.
 - Fasteners: Hot-dip galvanized high-strength bolts, nuts, and washers.
10. Configuration:
 - Overall Height: see drawings.
 - Overall Width: see drawings..
 - Construction: Modular, field-bolted sections.
 - Connections: Bolted only; no field welding permitted.
 - Base Plates: Steel base plates sized for imposed loads and drilled for anchor bolts.
 - Assembly shall be hot dipped galvanized.
11. Fabrication:
 - Fabricate racks plumb and true.
 - Grind exposed welds smooth.
 - Clearly mark components for field reassembly.
 - Assembly shall be hot dipped galvanized.

12. Finish:

- Hot-dip galvanize all rack components after fabrication in accordance with ASTM A123/A123M.
- Repair damaged galvanizing in accordance with ASTM A780 using zinc solder method only.

13. Installation:

- Install racks plumb, level, and securely anchored to concrete substrates.
- Tighten bolts to manufacturer's recommended torque.

2.12 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Hot-dip galvanized exterior miscellaneous steel trim.
- D. Prime interior miscellaneous steel trim with zinc-rich primer.

2.13 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize all fabrication items exposed to the exterior and other items noted to be galvanized to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop-primer, or if not shop-primed, prime as specified in Section 09 91 10 "Painting."
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop-primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
- C. High Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Basis-Of-Design Product: Kynar 500® FSF®.
 - 2. Pencil Hardness, ASTM D3363: F minimum.
 - 3. Dry Film Thickness, ASTM D1400: 0.20 mil primer coat plus 1.0 mil color coat and 0.4 mil clear topcoat, 2.6 mil total, minimum thickness.
 - 4. Color: TBD

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with

edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

- D. Install pipe columns on concrete footings with grouted base-plates. Position and grout column base-plates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout base-plates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 "Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 GALVANIZE REPAIRS

- A. Repair damaged galvanized coatings and on galvanized items with galvanized repair brazing rods (repairing hot-dip zinc coatings), ASTM A780.
 - Repair damaged or uncoated areas of hot-dip galvanized steel only by the zinc solder (low-melting zinc alloy rod) method in accordance with ASTM A780/A780M.
 - Zinc solder shall be a zinc-based alloy repair rod specifically manufactured for galvanizing repair, applied using controlled heat sufficient to melt the solder without damaging the surrounding galvanized coating.

- Zinc-rich paints, metallizing (thermal spray), or other repair methods are not permitted.
- Finished repair areas shall be continuous, adherent, and provide a zinc coating thickness not less than the surrounding hot-dip galvanized coating.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hot-Dipped galvanized, after fabrication, steel pipe and tube handrails and railings.
- B. Railing design, fabrication, and installation shall conform to all requirements of the Texas Accessibility Standards, and ADAAG.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails and Railings:
 - 1. Comply with ASTM E 985, based on testing per ASTM E 894 and ASTM E 935.
 - 2. Capable of withstanding the following structural loads without exceeding the allowable design working stress of materials involved:
 - a. Top Rail of Guards: Concentrated load of 200 lbf applied at any point and in any direction, and a uniform load of 50 lbf/ft. applied horizontally and concurrently

with uniform load of 100 lbf/ft. applied vertically downward. Concentrated and uniform loads need not be assumed to act concurrently.

- b. Handrails Not Serving as Top Rails: Concentrated load of 200 lbf applied at any point and in any direction, and a uniform load of 50 lbf/ft. applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.
 - c. Infill Area of Guards: Horizontal concentrated load of 200 lbf applied to 1 sq.ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Load on infill area need not be assumed to act concurrently with loads on top rails.
- B. Thermal Movements: Provide handrails and railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Field welding or cutting of exterior handrail assembly after completion of hot dip galvanizing is not permitted.

1.5 SUBMITTALS

- A. Product Data: For the following:
- 1. Manufacturer's product lines of mechanically connected handrails and railings.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of handrails and railings that are similar to those indicated for this Project in material, design, and extent.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 PROJECT CONDITIONS

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

1.9 COORDINATION

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

1.10 SCHEDULING

- A. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
- C. Pipe: ASTM A 53, Type F or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required or allowed by required structural loads.
 - 1. Provide hot-dipped, galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.
- E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 WELDING MATERIALS, FASTENERS AND ANCHORS

- A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
 - 1. Type 316L stainless steel w/ #8 finish for exposed fasteners.
- C. Anchors: Fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined per ASTM E 488.

2.4 GROUT AND ANCHORING CEMENT

- A. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

- A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble handrails and railings in the 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. Use connections that maintain structural value of joined pieces.
- C. Form changes in direction of railing members as follows:
 - 1. As detailed.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- E. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- F. Brackets, Flanges, Fittings, and Anchors: Fabricated wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
 - 1. Exterior Handrail Brackets: Custom fabricated as indicated of Type 316L stainless steel.
- G. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
- H. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- I. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

- J. Cut, reinforce, drill and tap components, as indicated, to receive finish hardware, screws, and similar items.
- K. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
- L. Fabricate joints that will be exposed to weather in a watertight manner.
- M. Close exposed ends of handrail and railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails. Close ends of returns.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railings.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior, and indicated, steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
 - 1. Comply with SSPC-SP 16.
- D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces for products specified in Section 09 91 00. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:
 - 1. Non-shrink, non-metallic grout or anchoring cement.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:
 - 1. Non-shrink, non-metallic grout or anchoring cement.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch build-up, sloped away from post.

3.5 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.

3.6 REPAIR

- A. Field Repairs of Hot-Dip Galvanized Metal Finishes: Where approved by Architect, minor damages or imperfections may be refinished as follows:

1. Preparation: Remove oil or soap film with detergent or emulsion cleaner. Power clean surface to SSPC SP 11.
2. Surfaces to Receive Paint Finish: Apply one coat of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (applied immediately after preparation completed.)
3. Surface with Exposed Galvanized Finish: Apply two coats of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (Apply first coat immediately after preparation completed.)

3.7 PROTECTION

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

END OF SECTION 05 52 13

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

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 with dimension lumber.
- 2. Rooftop equipment bases and support curbs.
- 3. Wood blocking, cants, and nailers.
- 4. Wood furring and grounds.
- 5. Wood sleepers.
- 6. Plywood backing panels.

- B. Related Requirements:

- 1. Division 06 Section "Sheathing" for exterior gypsum wall sheathing.
- 2. Division 06 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view, and not specified in another Section.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections, and not exposed, unless otherwise indicated.
- B. Exposed Framing: Framing not concealed by other construction.
- C. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- D. Timber: Lumber of 5 inches nominal or greater in least dimension.
- E. 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.

1.4 ACTION SUBMITTALS

- A. 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. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Power-driven fasteners.
 4. Powder-actuated fasteners.
 5. Expansion anchors.
 6. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be 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."
 - 1. Dimension lumber framing.
 - 2. Timber.
 - 3. Laminated-veneer lumber.
 - 4. Parallel-strand lumber.
 - 5. Miscellaneous lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the 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, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.

- C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
- D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. 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.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat all rough carpentry unless otherwise indicated and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
- C. Use treatment that does not promote corrosion of metal fasteners.
 1. Exterior type is suitable for both exterior and interior applications. Interior type is only for interior applications.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- E. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

- F. Retain only first option in subparagraph below if authorities having jurisdiction require classification marking on all materials.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- G. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- H. Application: Treat all rough carpentry unless otherwise indicated, and the following:
 - 1. Framing for raised platforms.
 - 2. Framing for stages.
 - 3. Concealed blocking.
 - 4. Framing for non-load-bearing partitions.
 - 5. Framing for non-load-bearing exterior walls.
 - 6. Roof construction.
 - 7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions:
 - 1. Application: Interior partitions not indicated as load bearing.
 - 2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB, or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - f. Northern species includes hem-fir (north) and spruce-pine-fir.
 - g. Northern species; NLGA.
 - h. Eastern softwoods includes spruce-pine-fir (south).
 - i. Eastern softwoods; NeLMA.
 - j. Western woods includes hem-fir and spruce-pine-fir (south).
 - k. Western woods; WCLIB or WWPA.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking for TV, Security Monitors, and other wall mounted equipment.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. For items of dimension lumber size, provide Construction or No. 2 and the following species:
1. Hem-fir (north); NLGA.
 2. Mixed southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Western woods includes hem-fir and spruce-pine-fir (south).
 7. Western woods; WCLIB or WWPA.
 8. Northern species includes hem-fir (north) and spruce-pine-fir.
 9. Eastern softwoods includes spruce-pine-fir (south).
 10. Eastern softwoods; NeLMA.
- C. For utility shelving, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine.
 2. Mixed southern pine; No. 1 grade; SPIB.
 3. Spruce-pine-fir (south) or spruce-pine-fir.
- D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine; No. 2 grade; SPIB.
 2. Spruce-pine-fir (south) or spruce-pine-fir.
 3. Western woods; Construction or No. 2 Common.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 PLYWOOD BLOCKING

- A. Plywood Blocking: where indicated on the Drawings provide DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.
 - 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. NES NER-272 covers power-driven staples, nails, P-nails, and allied fasteners.
- D. Power-Driven Fasteners: NES NER-272.
- E. Wood Screws: ASME B18.6.1.

- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Fastenings for Wall Supported Items: Provide and install 2 x 8 (minimum) x 1 stud space wood blocking, unless specified otherwise at all stud wall areas receiving grab bars, toilet partitions, wall bumpers and other wall mounted accessories.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.
 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- I. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with the function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with fastener patterns where applicable.

2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 ROUGH HARDWARE

- A. Provide bolts, screws, anchors, inserts and fastenings required for proper attachment of carpentry and millwork items. Fastenings to concrete or masonry with expansion bolts or anchors. Toggle bolts may be used for hollow masonry. Fastening to wood plugs not permitted. Fastenings spaced 16" o.c. unless otherwise noted.

3.4 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.

END OF SECTION 06 10 53

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall sheathing

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of sheathing product. Include manufacturer's technical data indicating performance properties.
- B. Shop Drawings: Indicating location and extent of sheathing, accessories, and assemblies. Include details of joints, corners, and penetrations.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: From ICC-ES, for wood sheathing products.
- B. Product Certifications: From manufacturer, indicating that sheathing products comply with indicated ICC-ES Acceptance Criteria.
- C. Warranty: Sample unexecuted copy of manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty: Executed copy of manufacturer's warranty.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for protection of sheathing products from weather prior to installation.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.

- 1. Warranty Period for Sheathing Products: Limited Lifetime warranty

PART 2 - PRODUCTS

2.1 PLYWOOD EXTERIOR WALL SHEATHING

A. Plywood Sheathing: AdvanTech Plywood Sheathing

Product Data: 5/8" AdvanTech Tongue and Groove Sheathing

Manufacture: Huber Engineered Woods, LLC

Typical Panel: Size 4'x8' nominal

Nominal Thickness: 5/8"

Application: Exterior Walls

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide approved products that are part of fire-resistance-rated assemblies tested in accordance with ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- B. Provide panels that will not delaminate nor require sanding due to moisture absorption while exposed during construction.
- C. Panel Thickness: Provide thickness needed to meet project requirements and comply with referenced performance category, but not less than thickness indicated.

2.3 WOOD PANEL PRODUCTS

- A. Single Source Limitations: Provide wall sheathing by a single manufacturer.
- B. Oriented Strand Board: Comply with the following Product Standards:
 - 1. US Department of Commerce DOC PS 2 - Performance Standard for Wood-Based Structural Panels
 - a. Panels made with binder containing no added urea formaldehyde, with visible grade stamp and field identification.
 - 2. ICC-ES AC182- Acceptance Criteria for Wood Structural Panel Products

2.4 WALL SHEATHING

- A. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural 1 sheathing.
 - 1. Basis-of-Design Product: Huber Engineered Woods LLC; AdvanTech® Sheathing.
 - 2. Characteristics

- a. Span Rating and Performance Category: Not less than 5/8"
- b. Edge Profile: Tongue and groove.

2.5 FASTENERS

- A. Wood Screws: #10 - 1 7/16" 304 Stainless steel wood to metal screws

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing spacing and alignment to determine if work is ready to receive sheathing. Proceed with sheathing work once conditions meet requirements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. Sheathing Installation, General: Install sheathing panels in accordance with manufacturer's written instructions, requirements of applicable Evaluation Reports, and requirements of authorities having jurisdiction.
 - 1. Do not bridge expansion joints; allow joint spacing equal to spacing of structural supports.
 - 2. Stagger end joints of adjacent panel runs.
 - 3. Continuously support panel ends.
 - 4. Continuously support panel edges without tongue-and-groove edge profile where indicated.
 - 5. Attach sheathing panels securely to substrate with manufacturer-approved fasteners in compliance with the following:
 - a. ICC-ES ESR-1539 - Power Driven Staples and Nails for Use in Engineered and Non-Engineered Connections or ICC-ES NER-272 - Power Driven Staples and Nails for Use in All Types of Building Construction Retain one of two subparagraphs based on applicable building code for project.
 - a. [ICC IBC - International Building Code Table 2304.9.1 Fastening Schedule.]
 - 6. Comply with applicable portions of The Engineered Wood Association APA Form No. E30 - Engineered Wood Construction Guide
 - 7. Optimize joint arrangements resulting in minimum number of joints. Cut panels cleanly at penetrations.
- B. Wall Sheathing Fastening
 - 1. Cold-Formed Metal Framing: #10 - 1 7/16" 304 Stainless steel wood to metal
 - 2. Install fasteners to 1/2 inch from panel edges.
 - 3. Space fasteners 6 inches on centers on supported panel edges and 12 inches on centers at intermediate support locations.

END OF SECTION 06 16 00

SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Paneling.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 09 91 00 "Painting" for priming and backpriming of interior finish carpentry.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Interior wood trim.
2. Shiplap Wall Paneling.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

D. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
 - 1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 - 2. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. For exposed lumber, omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.

2.2 INTERIOR TRIM

A. Interior Wood Trim Around Windows & Doors for Opaque Finish (Painted Finish):

1. Species and Grade: Southern pine, Clear No. 2.
2. Maximum Moisture Content for Softwoods: 19 percent.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).
5. Width: As indicated on the Drawings.
6. Min. Thickness: 3/4 inches (19.05 mm).
7. Length: 8 feet (2438.4 mm) minimum.

2.3 INTERIOR PANELING

A. Shiplap Wall Paneling:

1. Species: Southern pine.
2. Grade: C&Better.
3. Maximum Moisture Content: 19 percent.
4. Pattern: Nickelgap.
5. Net Coverage Width: Not less than 7-1/4 inches (184.15 mm).
6. Min. Thickness: 23/32 inches (1.83 mm).
7. Length: Random, 12' to 16'.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Stainless Steel or Hot-dip galvanized, nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 INSTALLATION OF INTERIOR TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 48 inches (1220 mm) long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Install trim after gypsum-board joint finishing operations are completed.
 - 7. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
 - 8. Fasten to prevent movement or warping.
 - 9. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 INSTALLATION OF PANELING

- A. Board Paneling: Install according to manufacturer's written instructions.
 - 1. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
 - 2. Stagger end joints in random pattern to uniformly distribute joints on each wall.
 - 3. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
 - 4. Install with uniform end joints. Locate end joints only over furring or blocking.
 - 5. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
 - 6. Install with uniform tight joints between boards.
 - 7. Fasten paneling by blind nailing through tongues.
 - 8. Where necessary, countersink fastener heads on exposed carpentry work and fill holes.

3.6 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.
 - 1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.7 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces.
- B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 23

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood cabinets for transparent finish
 - 2. Solid wood trim for transparent finish.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood furring (regular type), blocking, shims and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 8 Section "Flush Wood Doors".
- C. Register, provide, and comply with AWI (Quality) Certification Program by applying labels and certificates of compliance indicating that woodwork & woodwork installation complies with requirements of grades specified. Provide AWI program certificates as part of the close-out documentation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories, handrail brackets and finishing materials and processes.
- B. Product Data: For hardboard, medium-density fiberboard, particleboard, plywood, high-pressure decorative laminate, adhesive for bonding plastic laminate, thermoset decorative overlay, cabinet hardware and accessories, handrail brackets and finishing materials and processes.

- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 - 5. Apply AWI QCP registration number on first page of Shop Drawings.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Wood cabinet doors and exposed frames.
 - 2. Wood trim.
- E. Samples for Verification: For the following:
 - 1. Plastic-laminate-clad panel products, 8 by 10 inches, for each type, color, pattern, and surface finish, with separate samples of un-faced panel product used for core.
 - 2. Thermoset decorative-overlay surfaced panel products, 8 by 10 inches, for each type, color, pattern, and surface finish.
 - 3. Cabinet hardware and accessories, one unit for each type and finish.
 - 4. At Architects discretion provide full size sample base cabinet with drawer, door, and countertop.
- F. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements. Provide 3 original AWI Quality Certification Program certificates to Architect.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified. Indicate AWI membership and compliance.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Register, provide and comply with AWI (Quality) Certification Program by applying labels and certificates of compliance indicating that woodwork installation complies with requirements of grades specified. Provide AWI program certificates as part of the close-out documentation.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. See requirements for AWI program certification above.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes and other requirements.
- E. Warranty: Woodworker shall provide Written warranty for all materials and Fabrications. Casework warranty covering all cabinets and countertops shall be carry a 10-year guarantee against manufactures defects. Cabinet hinges and drawer guide systems shall carry a lifetime guarantee.
- F. Close-out Documents: Provide 3 copies of operations and maintenance instructions for the complete millwork package. O&M binder shall include listing of all material sources and proper care instructions for plastic laminate, hardware, solid surface and other specialty items. Include specific manufacturers' brochures and recommendations. A copy of AWI QCP certificate and the millwork written warranty shall be included in the booklet.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in the "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and will maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:
 - 1. Any fabricator with current active membership and participation in AWI Quality Certification Program.

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 3. Hardwood Plywood and Face Veneers: HPVA HP-1.
- C. Metal Counter Support Brackets:
 - 1. A&M Hardware Inc. workstation bracket or approved equivalent.
 - 2. 10 GA steel, powder coat finish, size as required based on counter depth.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: AWI Premium Grade.
- B. Type of Construction: Face frame.
- C. Cabinet and Door and Drawer Front Interface Style: Reveal overlay.
- D. Reveal Dimension: 1/2 inch.
- E. Wood for Exposed Surfaces:
 - 1. Species: White Oak
 - 2. Cut: Rift cut; A4 select.
 - 3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
 - 4. Matching of Veneer Leaves: Book match.
 - 5. Veneer Matching within Panel Face: Running match.
 - 6. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- F. Semi-exposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
 - 2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
 - 3. Drawer Bottoms: Hardwood plywood.
- G. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- H. Drawer Construction: Fabricate with exposed fronts fastened to sub-front with mounting screws from interior of body.
 - 1. Join sub-fronts, backs, and sides with glued dovetail joints.
- I. Finish: Pre-finished. AWI System-11; Polyurethane, Catalyzed.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware" (Scheduled by Naming Products).

- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Butt Hinges: For Plastic Laminate and Wood Cabinets for Opaque Finish; 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch- thick metal, and as follows: Equal to Rockford # 376-26D.
 - 1. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- D. Concealed Hinges (European Type): For Wood Cabinets for Transparent Finish; BHMA A156.9, B01602, 135 degrees of opening, self-closing.
 - 1. Blum; "Blumotion," Compact 33 Series, Small Overlay hinge.
- E. Pulls: Back mounted. Equal to R. Christensen by Berenson Hardware; Skyline 2 Collection , #9203-1BPN-P, Brushed Nickel.
- F. Catches: Equal to Epco #592 heavy duty Magnetic catch 7-lb pull.
- G. Adjustable Shelf Standards and Supports: Equal KV #255ZC and KV #80 ANO/180 ANO.
- H. Shelf Rests: BHMA A156.9, B04013. Equal to KV #256ZC.
- I. Drawer Slides: Equal to Blum Metabox system "Lifetime Warranty" White epoxy coated drawer Sides.
 - 1. Box Drawer Slides: 100 lb. rated Blum #330M full extension.
- J. Door Locks: BHMA A156.11, E07121. Timberline #CB-230 cylinder body, #LP-100 lock plugs nickel finish, #CB-175 for sliding Wood doors and Glass door tracks. Master key all locks.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 SOLID WOOD TRIM FOR TRANSPARENT FINISH

- A. Solid Wood Trim: Where indicated on the Drawings, provide solid, white oak wood trim of shape indicated with color and grain pattern to match the Veneered Plywood Wall Panels.
- B. Jointing: Miter outside joints, miter or cope inside joints, and miter/ lap end joints.
- C. Finish: Pre-finished. AWI System-11; Polyurethane, Catalyzed.

2.6 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.7 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles and details indicated.
- D. Complete fabrication, including assembly, finishing and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.8 SOLID SURFACE COUNTERTOPS AND BACKSPLASH

- A. Refer to Division 06, Section Solid Surface Countertops and Fabrication.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.2 SHOP FINISHING

- A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
- C. Transparent Finish: AWI Finish System - 11, catalyzed polyurethane.

3.3 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved. Installer shall be trained in AWI QCP installation requirements for installation.
- B. Install woodwork level, plumb, true and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.
 - 1. Standing and Running Trim: Install with minimum number of joints possible, using full-length sections.
- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops with no more than 1/8 inch in 96-inch sag, bow or other variation from a straight line.
 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants".
- G. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23

SECTION 07 21 00 - THERMAL INSULATION

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. Mineral-wool blanket, wall insulation in exterior, metal stud framed walls.
 - 2. Mineral-wool board, fire safing insulation where indicated.
 - 3. Refer to 3.6 INSULATION SCHEDULE, this section, for insulation schedule/additional references.
- B. Related Requirements:
 - 1. Section 07 27 26, "Fluid-Applied Membrane Air Barrier System" for air/vapor barrier over which insulation will be applied.
 - 2. Section 07 41 13, "Metal Roof Panels" for thermal insulation installed under metal roof panels.
 - 3. Section 09 81 00 "Sound Attenuation Batt Insulation" for sound attenuation blanket used as acoustic insulation.
 - 4. Division 23, Section "Duct Insulation" for HVAC duct insulation.

1.3 REFERENCES

- A. Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation ASTM C203
- B. Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D1621
- C. Test Method for Apparent Density of Rigid Cellular Plastics ASTM D1622
- D. Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging ASTM D2126
- E. Test Method for Water Vapor Transmission of Materials ASTM E96/E96M
- F. National Fire Protection Association (NFPA) 285: Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall

Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product verifying qualities of insulation components meet or exceed specified requirements.
- D. Manufacturers printed installation instructions for each type of material to be used.
- E. Samples: Submit the following material samples:
 - 1. 12" square insulation panels of each type and thickness of insulation specified.
 - 2. Thru-wall flashing minimum of 12" long and of width specified.
- F. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Provide each type of building insulation and related accessories from one single manufacturer.
- B. Installer Qualifications:
 - 1. Contractor shall provide evidence of having completed 3 projects of similar size and scope in the past 3 years.
 - 2. Contractor shall provide evidence of certification by the rigid insulation manufacturer as having been properly trained in the proper installation of the submitted products.
- C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test- response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 POLYISOCYANURATE BOARD INSULATION

- A. Foil-Faced, Polyisocyanurate Board Insulation in exterior wall cavities: ASTM C1289, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of ≤ 25 and ≤ 450 , respectively, per ASTM E84.
 - 1. Minimum Compressive Strength ≥ 25 psi when tested per ASTM D1621
 - 2. Minimum Tensile Strength ≥ 1000 when tested per ASTM C209
 - 3. Minimum Flexural Strength ≥ 40 psi when tested per ASTM C203
 - 4. Water Vapor Transmission ≤ 0.03 perms per inch when tested per ASTM E96
 - 5. Water Absorption Maximum $\leq 1\%$ by volume when tested per ASTM C209
 - 6. Dimensional Stability, Maximum $\leq 0.05\%$ length and width, and $\leq 3.5\%$ thickness when tested per ASTM D2126
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Basis of Design: APTM Foil-Faced Polyisocyanurate Continuous Insulation; as manufactured by Johns Manville.
 - 2. Firestone Building Products; Enverge CI Foil Exterior Wall Insulation
 - 3. Atlas Roofing Corporation; EnergyShield® Pro.
 - 4. Dow Chemical; Thermax.
 - 5. Or other equivalent insulation.
- C. Physical and Performance Requirements:

1. Board Size: 24 x 48 inches.
2. Board Thickness: Nominal 1-inches, unless otherwise noted.
3. Required Thermal Resistance: $R = 6.0$.
4. Board Edges: Square.
5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 0 and 0, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

1. Thickness: Nominal 6-inches.
2. Required Thermal Resistance: $R = 25$ for 8" thickness.
3. Board Edges: Square.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Rockwool, Comfortbatt™.
2. Owens Corning, Thermafiber.
3. Johns Manville, TempControl®.
4. Or other equivalent insulation.

2.3 MISCELLANEOUS INSULATION

- A. Insulation for Miscellaneous Voids:

1. Mineral-Wool Board, Types IVA, Unfaced, Safing Insulation: ASTM C612, Types IVA; with maximum flame-spread and smoke-developed indexes of zero and zero, respectively, per ASTM E84; Non-Combustible at 750° per ASTM E136 for combustion characteristics. Nominal density of 4.4 lb/cu. ft. (70 kg/cu. m) per ASTM C303. Moisture Absorption $\geq 0.03\%$ per ASTM C1104.
 - a. Rockwool; Roxul Safe™45.
 - b. Owens Corning; Thermafiber® Safing.
 - c. Or approved equal.

2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Abut wall insulation tightly together both horizontally and vertically, and at all openings.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly between masonry wall ties and around obstructions. Fill all voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Install batt insulation without visible voids, gaps or separations. Place insulation in Cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Cut and trim

insulation neatly to fit spaces without laps, bulges or folds. Use batts free of rips and tears.

3. Fit insulation tight within spaces and tight to and behind mechanical and electrical wiring.
4. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.6 INSULATION SCHEDULE

- A. EXTERIOR CONTINUOUS RIGID INSULATION: Foil-Faced, Polyisocyanurate Continuous Board Insulation in exterior wall cavities 1" thick.
- B. METAL BUILDING ROOF INSULATION: See Section 07 41 13, "Metal Roof Panels" for insulation to be used with metal roofing systems.
- C. MINERAL-WOOL BLANKET WALL INSULATION: Provide Mineral-Wool Blanket **in exterior, metal stud wall framing**; ASTM C 665, Type I, unfaced, as specified in Article 2.2; nominal 6-inches thick, unless otherwise indicated, with minimum total R-value of 25.0 for 8-inch thick blanket.
- D. SOUND ATTENUATION BATT INSULATION: See Section 09 81 00, "Acoustical Insulation."

END OF SECTION 07 21 00

SECTION 07 27 26 – FLUID-APPLIED MEMBRANE AIR BARRIER SYSTEM

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 SECTION INCLUDES

- A. Fluid-applied, elastic, membrane air and water barrier located in the non-accessible part of the wall.
- B. Materials and installation to bridge and seal air leakage pathways and gaps, including but not limited to the following:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundations.
 - 3. Expansion joints.
 - 4. Openings and penetrations of window frames, store front, curtain wall.
 - 5. Barrier precast concrete and other envelope assembly.
 - 6. Door frames.
 - 7. Piping, conduit, duct and similar penetrations.
 - 8. Masonry ties, screws, bolts and similar penetrations.
 - 9. All other air leakage pathways in the building envelope.
 - 10. Sealing flashing to wall surface.

1.3 RELATED SECTIONS

- A. Section 06 10 53 "Miscellaneous Rough Carpentry" for covering preservative-treated materials with self-adhering membranes.
- B. Section 06 16 00 " Sheathing" for substrate over which air barrier membrane will be installed.
- C. Section 07 21 00 "Thermal Insulation" for attachment and compatibility of insulation installed over membrane air barrier.
- D. Section 07 62 00 "Sheet Metal Flashing for through wall flashing and flexible flashing to structural members.

- E. Section 07 92 00 – Joint Sealants compatibility with joint sealers installation as part of the substrate to receive the membrane air barrier system.

1.4 PERFORMANCE REFERENCES

- A. ASTM E 2178-01: Standard Test for Determining the Air Permeability of Building Materials.
- B. ASTM E 2357, Standard Test Method for Determining Air Leakage of Air Barrier Assembly (Full Scale Wall Testing of the Air Barrier System). Ensure tests were conducted on steel stud frame walls with penetrations (Specimen 2) as some air barrier assemblies are not tested in that critical mode.
- C. ASTM E283-91: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- D. CODE MANDATED ASTM E331: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- E. ASTM E96: Water Vapor Transmission of Materials, Procedure B.
- F. AATCC 127 Water Resistance.
- G. ASTM D 1970, Self Sealability.
- H. ICC-ES AC212, Freeze Thaw, Crack Bridging
- I. CODE MANDATED Fire Testing: Air Barrier, as a component of a wall assembly, shall have passed a NFPA 285 complete wall fire test.
- J. ASTM E84, Standard Test Method for Surface Burning.

1.5 PERFORMANCE REQUIREMENTS

- A. Dampproofing Membrane Continuity: The application of the dampproofing products and methods, when complete, shall provide a continuous and unbroken vapor membrane building “enclosure” on all exterior walls and building roof footprint. Special attention shall be paid to all door, window and louver penetrations and proper membrane continuity between the exterior cavity wall membrane and the specified roof system. See wall sections and associated enlarged details.
- B. Provide an air barrier system constructed to perform as a continuous elastic air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building

materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

1. The air barrier shall have the following characteristics:
 - a. It must be continuous, with all joints made air-tight.
 - b. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement and shall transfer the load to the structure. It shall not displace adjacent materials under full load. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent assembly, allowing for the relative movement of assembly due to thermal and moisture variations and creep. Connection shall be made between:
 - 1) Foundation and walls.
 - 2) Walls, windows, curtain walls, storefronts, louvers, and doors.
 - 3) Different assemblies and fixed openings within those assemblies.
 - 4) Wall and roof connections.
 - 5) Wall and roof over unconditioned space.
 - 6) Walls, floor and roof across construction, control and expansion joints.
 - 7) Walls, floors and roof to utility, pipe and duct penetrations.
 - 8) Flashing to wall surface.
 - 9) Seismic and expansion joints.
2. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
3. Air Permeability: Maximum 0.04 cfm/sq.ft. @ 10.5 psf per ASTM E283.
4. Air Permeability: @ delta P of 0.3 inches water...0.002 CFM/ft² per ASTM E 2178
 - a. ASTM E 2357, Full Scale Wall Testing of the Air Barrier System
 - b. System Air Leakage, Requirement – 0.0008 CFM/ft² maximum
5. Penetration Check, Requirement – 0.00088 CFM/ft² maximum
6. ASTM E96 Water Vapor Permeance: 10-20 perms per Procedure B.
7. ASTM E331, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference - 10 psf for 2 hours.
8. Elongation: Minimum 50% per ASTM D412.
9. AATC 127 Water Resistance – Pass.
10. ASTM D 1970 Self Sealability – Pass.
11. ICC-ES AC212, Freeze Thaw, Crack Bridging – Pass.
12. Fire Testing: Air Barrier, as a component of a wall assembly, shall have passed a NFPA 285 complete wall fire test.
13. ASTM E84 Class A, Fire Rating.

1.6 SUBMITTALS

- A. Submittal Procedures: Submit per Section 01 33 00 – Submittal Procedures.
- B. Quality Assurance Program: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program (QAP). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material Manufacturer's Product Data, material manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
 - 1. Submit letter from primary air barrier material manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that manufacturer's material.
 - 2. Include statement from the primary air barrier material manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
- D. Shop Drawings: Submit Shop Drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the materials are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.
 - 1. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.
 - 2. Include statement that materials are compatible with adjacent materials proposed for use.
 - 3. Include required values for field adhesion test on each substrate in accordance with ASTM D4541 (modified), using a type II pull tester.
- E. Samples: Submit clearly labelled samples, three (3) inch by four (4) inch [75 mm by 100 mm] minimum size of each material specified.
- F. Prior to commencing the Work, submit manufacturer's independent Laboratory Report for the Air Barrier Assembly testing on ASTM E 2357 tested on a steel stud frame wall, results are to be based on Specimen 2 testing only.
- G. Prior to commencing the Work, submit documentation certifying that the air barrier system has been tested independently, indicating compliance with the performance requirements of the Air Barrier Association of Association.

- H. Prior to commencing the Work, submit copies of manufacturers' literature for the system, membrane, primers, sealants, adhesives and associated auxiliary materials shall be included as parts of the system that is listed by the Air Barrier Association of America evaluation.
- I. Prior to commencing the Work, submit references clearly indicating that the materials proposed have been installed for not less than three years on projects of similar scope and nature.
- J. Prior to commencing the Work, submit manufacturers' complete set of standard details for air barrier/vapor retarders. The manufacturer's representative shall review the contract drawings and note any modifications required to make the system air and watertight.

1.7 QUALITY ASSURANCE

- A. Quality Assurance Program: The Contractor shall implement and comply with the requirements of the Air Barrier Association of America's (ABAA) Quality Assurance Program (QAP) for the project, including an audit of the project by an ABAA Certified Auditor. All deficiencies identified by the auditor shall be corrected prior to proceeding with any work that will necessitate removal and replacement to correct deficiencies in the air barrier system.
- B. Installers Qualifications: All work shall be performed by SABAA Certified Installers.
- C. Manufacturer's Qualifications: Provide primary products, including each component of the air barrier membrane system, which has been commercially available for a minimum of 3 years.
- D. Submit in writing, a document stating that the applicator of the primary air barrier membrane specified in this section is recognized by the manufacturer as suitable for the execution of the Work.
- E. Perform Work in accordance with the printed requirements of the air barrier manufacturer and this specification.
- F. Maintain one copy of manufacturer instructions on site.
- G. At 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.
- H. Compatibility: Submit letter from primary material manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

- I. Manufacturer: 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 (ABAA).

1.8 MOCK-UP

- A. Construct mock-up in accordance with Section 01 40 00 – Quality Requirements: Requirements for a mock-up.
- B. Location: Where indicated in the Drawings.
- C. Construct typical exterior wall panel: Items to be incorporated in mock-up include, but are not limited to, the following:
 - 1. For metal stud wall system: Masonry veneer system, through wall flexible flashing, glass-faced gypsum sheathing, wall ties, board insulation, metal studs, aluminium curtain wall frame, aluminium window frame, showing air barrier membrane application details and transition membranes.
 - 2. For masonry wall system: Masonry veneer system, concrete masonry backup, wall ties, through wall flexible flashing, board insulation, aluminium window frame, showing air barrier membrane application details and transition membranes.
- D. Allow 72 hours for inspection of mock-up by Architect before proceeding with air barrier work.

1.9 PRE-INSTALLATION MEETING

- A. Pre-Installation Meeting: Convene a minimum of four weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by representatives of related trades including covering materials, substrate materials and adjacent materials.
- B. DO NOT PROCEED WITH THE INSTALLATION OF THE AIR BARRIER MEMBRANE AND THE THROUGH WALL FLASHING MEMBRANE PRIOR TO THE PRE-INSTALLATION CONFERENCE.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within the temperature range required by material manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
- C. Handle materials in accordance with material manufacturer's recommendations.
- D. All pail goods shall bear the ABAA Evaluated Air Barrier label.
- E. Do not double stack pail goods.
- F. Keep all products stored at above 40°F. DO NOT ALLOW PRODUCT TO FREEZE.

1.11 PROJECT CONDITIONS

- A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material manufacturer. Do not apply air barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.
- C. Compatibility. Do not allow air barrier materials to come in contact with chemically incompatible materials.
- D. Ultra-violet exposure. Do not expose air barrier materials to sunlight longer than as recommended by the material manufacturer.

1.12 COORDINATION

- A. Ensure continuity of the air seal throughout the scope of this section.

1.13 WARRANTY

- A. Material Warranty: Provide material manufacturer's standard product warranty, for a minimum three (3) years from date of Substantial Completion.
- B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a two (2) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air

tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 AIR BARRIER MATERIALS

- A. Liquid air barrier: One component elastomeric membrane, spray, trowel or brush applied, having the following characteristics and have passed all evaluations by the Air Barrier Association of America (ABAA); and be listed on their web site as having passed all the evaluations:
1. Air permeability:
 - a. Air Leakage Thru Cured Films: $<0.04 \text{ cfm/ft}^2$ @ 10.5 lbs/ ft² or $<0.005 \text{ L/sm}^2$ @ 75 Pa to ASTM E283 (Modified) 24 hours, +/- 10%.
 - 1) Air Leakage per ASTM E 2178, dry film, delta P of 0.3 inches of water, 0.002 +/- 10%
 2. Air Barrier System Test on Full Scale Wall Assembly, ASTM E 2357
 - a. System Air Leakage, 0.0008 CFM/ft² +/- 10%
 - b. Penetrations Check, MUST PASS ASTM E 2357 requirements.
 3. Water Vapor permeance: (704 ng/Pa.m².s.) 10 to 20 perms, ASTM E96 Method B. NOTE: THE MATERIAL SPECIFIED IS VAPOR PERMEABLE.
 4. Elongation (ASTM D412: >50%).
 5. Low temperature flexibility and crack bridging: Pass – ICC-ES AC212.
 6. ASTM D 1970, Self Sealability – Pass.
 7. AATCC 127 Water Resistance – Pass.
 8. ASTM E84, Class A Fire Rating.
 9. Recycle content >20%.
- B. Acceptable Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide STC Coatings, Wall Guardian, FW-100-A as indicated below, or a comparable product by one of the following:
1. Basis-of-Design Product: STS Coatings; Wall Guardian, FW-100-A; 40 mil (wet), 20 mil (dry), Acrylic-based component.
 2. Grace Construction Products; Perm-A-Barrier VP; 90 mil (wet), 45 mil (dry).
 3. Other products/assembly meeting the performance requirements.

2.2 AIR BARRIER ACCESSORY MATERIALS:

- A. Transition Membrane, Self-Adhering: Polymer-based, sheet membrane complete with polyester facing, and having the following physical properties:
 - 1. Thickness: 35 mils (0.5 mm) min.
 - 2. Vapor permeance: <0.1.
 - 3. Low temperature flexibility: -20 F to CGSB 37-GP-56M.
 - 4. Elongation: >90% to ASTM D412-modified.
 - 5. ASTM E331, 10 psf for 2 hours.
 - a. Acceptable material:
 - 1) UT-40 by STS Coatings for use with the FW-100-A system.
 - 2) Others as approved by manufacturer.
- B. Primer for self-adhering membranes: Synthetic polymer-based adhesive type, quick setting, having the following characteristics:
 - 1. Acceptable material: As manufactured and/or recommended by the Air Barrier System manufacturer. Note: Primer shall be compatible with specified glass faced gypsum sheathing.
 - 2. Verify compatibility of self-adhering membranes with preservative treated materials specified in Section 06 10 00. Prime preservative treated materials as required using primer recommended by self-adhering membrane manufacturer or use the non-chemical thermally modified wood known as EcoPrem.
 - 3. Other Primers: As recommended by manufacturer for surfaces to be sealed.
- C. Base, Through-Wall Flashing, or Shelf Angle Flashing: As specified in Section 076500 - Base and Flexible Flashing.
- D. Mastics: None, non-asphaltic product.
- E. Transition Strip: Universal Tape, UT-40, by STS Coatings.
- F. Transition Mastic: Great Seal LT-100, by STS Coatings.
- G. Window Flashing and Detail Membrane: Universal Tape, UT-40, by STS Coatings.
- H. Sealants:
 - 1. Sealants shall be compatible with air barrier assembly and shall be approved by the air barrier manufacturer.
 - 2. Products: STS Coatings LT-100 Liquid Tape for concealed applications only, and "Great Seal" PE-150 for concealed and exposed applications.
- I. Backer Rods: As recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.
- B. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Architect in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.2 PREPARATION

- A. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrates to provide an even plane.
- B. Mortar joints in concrete block and form tie holes/voids in poured concrete shall be filled flush and smooth and allowed to be cured for a minimum of 24 hours.
- C. All joints between gypsum sheathing, roof board, masonry and concrete and other substrate joints up to 1/4" wide shall be treated:
 - 1. STS Coatings LT-100 Liquid Tape, www.stscoatings.com.
 - 2. York Manufacturing, US-100, www.yorkmfg.com.
 - 3. Others as recommended by manufacturer.
- D. All joints between gypsum sheathing, roof board, masonry and concrete and other substrates wider than 1/4" shall be sealed with:
 - 1. UT-40, overlapping each side of joint a minimum of 3 inches.
 - 2. Others as recommended by manufacturer.
- E. Install backer rod and sealant at the following joints:
 - 1. All expansion/control/erection joints between concrete wall panels.
 - 2. All expansion/control joints in concrete block back-up.
 - 3. All joints between concrete wall panels and concrete block back-up.

3.3 PRIMER FOR TRANSITION MEMBRANE (SELF-ADHERING TYPE ONLY)

- A. Apply primer for self-adhering membranes at rate recommended by manufacturer.
- B. Apply primer to all areas to receive transition sheet membrane as indicated in Drawings by roller or spray and allow minimum 30-minute open time. Primed surfaces not covered by transition membrane during the same working day must be re-primed.

3.4 TRANSITION MEMBRANE (SELF-ADHERING TYPE)

- A. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2-inch overlap at all end and side laps unless otherwise noted.
- B. Tie-in to roofing system and at the interface of dissimilar materials as indicated in Drawings.
- C. Promptly roll all laps and membrane with a countertop roller to affect seal.
- D. Ensure all preparatory work is complete prior to applying liquid membrane.

3.5 PRIMARY AIR BARRIER

- A. Apply by spray or roller, a complete and continuous unbroken film at a temperature of 40°F and rising with less than a 30% chance of rain in the next 18 hours and apply at the same rate as listed in the Air Barrier Association of America evaluation.
 - 1. Exterior Gypsum Sheathing, Plywood or OSB
 - a. Wall Guardian FW-100A at a minimum of 2.5 gallons per 100 ft² (40 ft²/gallon) (40 wet mils).
 - b. Others meeting stated requirements.
 - c. Spray around all projections, including masonry veneer anchors, ensuring a complete and continuous air seal.
 - 2. Concrete Masonry Unit (CMU), Concrete
 - a. Wall Guardian FW-100A at a minimum of 2.5 gallons per 100 ft² (40 ft²/gallon) (equal to 40 wet mils on a smooth surface).
 - b. Others meeting stated requirements.
 - c. Spray around all projections including masonry veneer anchors ensuring a complete and continuous air seal.

3.6 INSPECTION

- A. Notify Architect when sections of work are complete so as to allow for review prior to installing insulation. The manufacturer's representative shall be on site to review the installation along with the Architect.

3.7 PROTECTION OF FINISHED WORK

- A. Liquid membranes are not designed for permanent exposure. Cover the liquid membrane, as recommended by the manufacturer, within the following time frames. Contractor shall verify the number of calendar days with the air barrier manufacturer:
 - 1. Cover the Wall Guardian material within 180 calendar days after installation. The nature of this product is such that some surface weathering may become apparent during exposure. This is a surface effect only and does not impact air barrier system performance.
 - 2. Transition membranes shall be covered within 180 days after installation.
- B. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through the air barrier and at protrusions according to air barrier manufacturer's written instructions.

3.8 INSTALLATION

- A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material manufacturer's instructions and the following (unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
 - 1. Install veneer anchors as per air barrier manufacturer installation sequencing.
 - 2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material manufacturer.
 - 3. Apply primer for transition material at the rate instructed by the air barrier material manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set/cure completely before transition strip application.
 - 4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches unless greater overlap is recommended by the material manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
 - 5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches unless greater overlap is recommended by the material manufacturer. Roll all areas of transition strip including seams with roller.
 - 6. Seal around all penetrations with termination mastic/sealant, membrane counter-flashing or other procedure in accordance with material manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
 - 7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material manufacturer's instructions.

8. Provide transition material at changes in substrate plane (with bead of sealant/mastic, membrane counter-flashing or other material recommended by material manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining a 2-inch overlap on both edges.
10. For through-wall flashing and head-flashing, lap transition material over top edge of it.
11. Provide backup for the membrane to accommodate anticipated movement or use other manufacturer approved transition material at deflection and control joints.
12. Provide transition to the joint assemblies at expansion and seismic joints.
13. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the material manufacturer.
14. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
15. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material manufacturer.
16. Install primer for fluid-applied air barrier if instructed by material manufacturer.
17. Install fluid-applied membrane using equipment and methods recommended by manufacturer, to achieve a dry film thickness as required by the material manufacturer.

3.9 SCHEDULED: (WORK SCHEDULED, BUT NOT LIMITED TO THE FOLLOWING:)

- A. Install liquid membrane system over the entire surface of the glass faced sheathing in the following area. Seal all steel anchor penetrations airtight.
 1. In the wall cavity.
- B. Install liquid membrane system over the entire surface of the outer surface of the inner wythe of masonry. Seal any masonry anchor penetrations airtight.
- C. Install liquid membrane system over the entire surface of the outer surface of the concrete wall panels. Seal any masonry anchor penetrations airtight.
- D. Install liquid membrane system over the entire surface of the glass faced gypsum sheathing and/or roof board in the following area:
 1. Behind the metal parapet panels.
 2. Behind the metal wall and soffit panels.

- E. Hollow Metal Door Frames: Seal door frame to wall surface with transition membrane.
- F. Wall and Roof Junction: Seal wall to roof with transition membrane.
- G. Seal joints in glass-faced sheathing with tape in the following areas:
 - 1. Cement plaster soffit.
- H. Seal the top of sheathing to the underside of the roof assembly with foam or LT-100.
- I. Openings: Seal around the perimeter of all openings with transition membrane.
- J. Perimeter wood nailers at wall openings: Cover all exposed surfaces of wood nailers with transition membrane. Extend membrane over sheathing, masonry and metal framing as shown.
- K. Aluminum window frames with nailing flanges: Seal the nailing flanges to the wall surface with transition membrane.
- L. Aluminum window frames without nailing flanges: Seal frames to the wall surface with transition membrane.
- M. Aluminum storefront frames: Seal frames to the wall surface with transition membrane.
- N. Aluminum curtain wall frames: Seal frames to wall surface with transition membrane.

3.10 PROTECTING AND CLEANING

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material manufacturer's written instructions.
 - 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to the primary material manufacturer.

END OF SECTION 07 27 26

SECTION 07 41 13 - METAL ROOF AND WALL PANELS

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. Exposed-fastener, lap-seam, metal roof and wall panels.

- B. Related Sections:

- 1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for anchoring metal roof panels.
 - 2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 3. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review structural loading limitations of deck, purlins, and rafters during and after roofing.
 - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
 - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. TDI windstorm pressures per section 01 33 00 – Submittals/1.4D.
2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
3. Connections / Fasteners 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899)

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. Windstorm Inspection Forms: Copies of Texas Department of Insurance (TDI) Inspection Verification (WPI-2-BC-5) and Application of Certification of Compliance (WPI-1) Forms indicating completed roofing installation meet TDI requirements for Texas Windstorm Insurance Association.
- C. Warranties: Executed Warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 6 feet (1.75 m) by 12 feet (3.5 m) square by full thickness, including attachments, underlayment, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if approved in writing by the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- B. Roofing System Design: Provide membrane roofing system that is identical to system that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7:
 - 1. Corner Uplift Pressure: 147 lbf/ sq.ft.
 - 2. Perimeter Uplift Pressure: 84 lbf/ sq.ft.
 - 3. Field-of-Roof Uplift Pressure: 50 lbf/ sq.ft.
 - 4. Design Wind Speed: 160 miles-per-hour (3 second gust).
 - 5. Exposure Category: C.
 - 6. Importance Factor: 2.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- E. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 1. Fire/Windstorm Classification: Class 1A-165.
 2. Hail Resistance: SH.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 EXPOSED-FASTENER, LAP-SEAM, METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Corrugated-Profile, Exposed-Fastener Metal Roof Panels: Formed with alternating curved ribs spaced at 2.67 inches (68 mm) o.c. across width of panel.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide McELROY METAL R-Panel or a comparable product by one of the following:
 - a. Berridge Manufacturing Company.
 - b. CENTRIA.
 - c. MBCI.
 - d. Metal Sales Manufacturing Corporation.
 - e. Morin - A Kingspan Group Company.
 2. Metallic-Coated Steel (Galvalume) Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality.
 - a. Panel Height: 1.25 inch.
 - b. Minimum Slope: 1:12 with sealant
 - c. Nominal Thickness: 24 guage
 - d. Finishes: Smooth.

2.3 COLOR SCHEDULE

SCHEDULE 1 - COLOR SCHEDULE

- A) Exterior Wall Panels and Corner Trim: **Almond.**
- B) Trim and Downspouts: **Medium Bronze.**
- C) Roof: **Silver Metallic.**

2.1 SUSPENDED THERMAL INSULATION

- A. Zee-type Purlin Application: Provide purlin suspended thermal insulation system for installation with steel banding designed fastened to pre-engineered metal building under roof panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide OptiLiner® Banded Liner System, as manufactured by Owens Corning., or equivalent product from one of the following:
 - a. Thermal Design, Inc.
 - b. Therm-All, Inc.
 - 2. Insulation Performance Requirements:
 - a. Linear/Vapor Retarder: Water Vapor Sorption; <0.2% by Volume at 120°F (49°C), 95% R.H.
 - b. Thermal Insulation: Owen Corning™EcoTouch® Non-combustible per ASTM E136; Max Flame Spread of 25 & Make Smoke Developed Index 50 per ATM E84.
 - c. Layer R-Values: Bottom Layer, R-11 nominal; Top Layer, R-19 nominal.
 - d. System Total R-Value: R-30.
 - e. Support Banding: 1" galvanized steel straps.

2.2 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 144-inch (3658-mm) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 144-inch (3658-mm) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Panel Fasteners: Self-tapping stainless steel screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.3 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements

demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.4 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:

1. Metallic-Coated Steel (Galvalume) Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF SUSPENDED THERMAL INSULATION

- A. Install per manufacturer's recommendations and approved product shop drawings.

3.4 INSTALLATION OF METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water-resistive barriers and flashings that are concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
 6. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 144-inch (3658-mm) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- G. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- H. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- I. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.
- B. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

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. Formed Products:

- a. Formed roof drainage sheet metal fabrications.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Formed equipment support flashing.
 - d. Formed expansion-joint cover flashings.
 - e. Miscellaneous sheet metal accessories.
 - f. Precast concrete splash blocks.

- B. Related Sections:

- 1. Division 06 for wood nailers, curbs, and blocking.
 - 2. Division 07 for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
 - 3. Division 22 for requirements for modifying, repairing, or replacing roof mounted plumbing, and piping.
 - 4. Division 23 for requirements for modifying, repairing, or replacing roof mounted mechanical equipment.
 - 5. Division 26 for requirements for modifying, repairing, or replacing roof mounted electrical conduit, fixtures, and equipment.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):

- 1. A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. A 240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. A 653 - Steel Sheet, Zinc Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process.

4. A 666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 5. A 755 - Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 6. A 792 - Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 7. B 32B - Solder Metal.
 8. B 749 - Lead and Lead Alloy Strip, Sheet, and Plate Products.
 9. C 920 -Elastomeric Joint Sealants.
 10. C 1311B - Solvent Release Sealants.
 11. D 226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 12. D 1187 - Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 13. D 4397 - Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 14. D 4586 - Asphalt Roof Cement, Asbestos-Free.
 15. D 4601 - Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
- B. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.
- C. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA): Architectural Sheet Metal Manual.
- D. National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual for Architectural and Metal Products

1.4 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Edge Design: Fabricate and install parapet Copings that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist roof edge design pressure (P) as identified in ANSI/SPRI-ES-1, as calculated according to ASCE 7-16.
1. Project Location & Design Information:
 - a. Building Location: Single block bounded by 5th Ave, 6th Ave, Houston Street, and Elm Street in Portland, Texas
 - b. Roof Surface Height: 25 feet
 - c. Exposure Category: B
 - d. Occupancy Category: II
 - e. Estimated Design Pressures (Note: The Wind Up-lift Pressures identified below were estimated using the MetalEra.com *Wind Calculator* application and are being provided as a courtesy solely for bidding purposes. It is the responsibility of the

Contractor to verify the accuracy of these estimates and to provide systems that resist the loads required by the applicable Building Code. These estimates do not constitute "engineering" studies and the use of the information provided below does not relieve the Manufacturer or the Contractor from providing and installing code compliant systems.)

- 1) Horizontal Design Pressure: 69.8 psf. 150 mph wind speed.
- 2) Vertical Design Pressure: 86.3 psf.

- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.5 ACTION SUBMITTALS

- A. Product List: Submit list of proposed Products and manufacturers, including all items specified in Part 2 – Products or otherwise required by the Work.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- C. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
1. Identification of material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 4. Details of termination points and assemblies, including fixed points.
 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 7. Details of special conditions.
 8. Details of connections to adjoining work.
 9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

- D. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 - 3. Accessories and Miscellaneous Materials: Full-size Sample.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.
- B. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- C. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

- A. General: Work of this Section to physically protect membrane roofing, base flashings, and expansion joints from damage that would permit water leakage to building interior.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance, with three years minimum experience.
- C. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.

5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.9 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.
- B. Coordinate with demolition work and with work of other trades to ensure sufficient materials and manpower are available to completely replace and make watertight all roofing removed each day.
- C. Limit removal of existing sheet metal components, to ensure new membrane installation can be made watertight by end of day.
- D. Coordinate installation of flanged metal components, including gravel guards, pitch pans, and accessories to ensure strip-in with hot bitumen (where applicable) on same day they are installed.
- E. Schedule work to avoid storage on, and traffic over finished work.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 2. Aluminum-Zinc Alloy-Coated (Galvalume) Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
 3. Surface: Smooth, flat.
- C. Prepainted Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 1. Aluminum-Zinc Alloy-Coated (Galvalume) Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
 2. Surface: Smooth, flat.
 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Minimum Exposure Tests:
 - 1) Humidity Resistance: 2000 hours.
 - 2) Salt-Spray Resistance: 2000 hours.
 4. Color:
 - a. As selected by Architect from manufacturer's full range.
 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- D. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel. 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899)
 - 3. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329 or Series 300 stainless steel.
 - 4. Rust-resistant and compatible with materials to be joined.
 - 5. Length: As required for thickness of material to penetrate substrate 1/2-inch minimum.
- C. Mechanical Fasteners for Sheet Metal to Substrate Anchorage:
 - 1. Masonry: One-step, screw-type drive anchor (nailin); heat-treated, stress relieved, stainless steel pin; zinc jacketed; sized for intended application; minimum 1-1/4-inch length x 1/4-inch diameter; Hammer-Screw[®] manufactured by Powers Fasteners, Inc.
 - 2. Wood Blocking: Hexagonal head screws, stainless steel, with neoprene rubber washers; jacket color to match pre-painted sheet metal.
 - 3. Concrete: Same as masonry or other power actuated fasteners, suitable for application.

- D. Roofing Nails: Stainless steel (for fastening into ACQ treated lumber), hot-dipped galvanized or non-ferrous type for fastening into non-treated lumber); with annular rings, size as required to suit application; minimum 11-gage with 3/8-inch diameter head.
- E. Mechanical Fasteners for Sheet Metal to Metal Fabrications (Support Framing) Anchorage: Appropriate for purpose intended, size as required to suit application and achieve positive anchorage to substrate material.
- F. Solder:
 - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. For Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
 - 3. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- G. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- H. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus, as specified in Division 07 Section "Sealants (for Roofing)"; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- I. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- J. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- K. Penetration Seal System: ChemCurb™ System – Penetration Seals, manufactured by Chem Linc, Inc. 416 E. Ransom St., Kalamazoo, MI 49007, (880-826-1681).
 - 1. Curb Components: Precast, polymer modified cement or structural urethane.
 - 2. Curb Adhesive: Special silicone sealant – DURALINK™.
 - 3. Pourable Sealant: Two-component urethane.
- L. Splash Blocks: Precast concrete of size and profile indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment; suitable for downspouts discharging at grade level or onto roof surface.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
- C. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- D. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- E. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.
- F. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with elastomeric sealant concealed within joints.
 - 1. Fabricate all components with allowance for expansion at joints. Provide enlarged or oval holes at all piercing fasteners.
- G. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- H. Form all sheet metal components (except corners) in longest practical length up to 10-feet maximum, true to shape, square, accurate in size, and free from distortion or defects detrimental to appearance or performance.
- I. Fabricate corners on all sheet metal components (gravel guards, copings, cap flashings, etc.) to form one piece with minimum 18-inch and maximum 36-inch long legs.
- J. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- K. Soldered Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

- L. Unsoldered Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- M. Hem exposed edges of metal 1/2-inch; miter and seam corners.
- N. Fabricate vertical faces with bottom edge formed outward 3/4-inch at 30 degrees and hemmed to form drip.
 - 1. Where vertical height exceeds 8-inches, fabricate with stiffing grooves in accordance with SMACNA, unless specifically approved otherwise.
- O. Form all sheet metal material to provide watertight joints:
 - 1. Unprotected Horizontal Surfaces (expansion joint covers, etc.): Standing seam or drive cleat joints.
 - 2. Vertical Surfaces (copings, cap flashings, gravel guards, etc.): Flat lock or cover and backer plate seams.
- P. Miter all sheet metal corners and solder, weld, or fasten and seal all joints watertight:
 - 1. Prepainted metallic-coated steel sheet: Apply minimum 1/4-inch bead of sealant between connecting metal flanges and drill and fasten with rivets at 2-inches o.c.
 - 2. Stainless Steel: Solder joints watertight.
 - 3. Unfinished Galvanized Steel: Solder joints watertight.
 - 4. After soldering, remove flux. Wipe and wash solder joints clean.
 - 5. Install sealant so it will not be visible on outside of joints.
- Q. Fabricate elements complete with required connection pieces.
- R. Fabricate all components with horizontal (flat) surfaces with built-in slope for drainage toward roof unless indicated otherwise.
- S. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Furnish with 6-inch- wide, joint cover plates.
 - 1. Joint Style: Butt, with 12-inch- wide concealed backup plate and 6-inch- wide exposed cover plates.
 - 2. Fabricate with scuppers spaced at existing locations or where indicated on the roof plan, of dimensions required with 4-inch- wide flanges and base extending 4-inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
 - 3. Fabricate roof edge flashing from the following material:

- a. Aluminum-Zinc Alloy-Coated (Galvalume) Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
4. Fabricate roof edge cleats from the following material:
 - a. Stainless Steel: 0.028 inch (22-gage) thick.
- B. Roof and Roof to Wall Transition; Roof to Roof Edge Flashing (Gravel Stop) Transition; and Expansion-Joint Cover: Fabricate from the following materials:
 1. Stainless Steel: 0.022 inch (24-gage) thick.
- C. Parapet Coping: Sheet metal parapet cap, fabricated to dimension indicated on the Drawings. Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated (Galvalume) Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
 2. Fabricate roof edge cleats from the following material:
 - a. Stainless Steel: 0.028 inch (22-gage) thick.
- D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:
 1. Stainless Steel: 0.022 inch (24-gage) thick.
- E. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 1. Galvanized Steel: 0.022 inch (24-gage) thick.
 2. Fabricated Hanger Style: As indicated on Drawings.
- F. Counterflashing: Fabricate from the following materials:
 1. Stainless Steel: 0.022 inch (24-gage) thick.
- G. Flashing Receivers: Fabricate from the following materials:
 1. Stainless Steel: 0.019 inch (26-gage) thick.
- H. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Stainless Steel: 0.019 inch (26-gage) thick.
- I. Soil Pipe Flashing: Fabricate from the following material:

1. Lead: 4.0 lb/sq. ft., hard tempered.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:

1. Prepainted Metallic Coated Galvalume Steel: 0.028 inch (22-gage) thick.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
 4. Verify membrane termination and base flashings are in place, sealed, and secure.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as recommended by SMACNA and as indicated on Drawings.
- B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

- A. Field measure site conditions prior to fabricating work.
- B. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Provide continuous cleats fastened not more than 12-inches on center. Anchor cleats with a minimum of two (2) fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
 - 1. Coat back side of stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - a. Minimum Dry Film Thickness: 15-mils.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
 3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- D. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10-feet. Provide joints within 18- to 36-inches of all corners or intersections. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with elastomeric sealant concealed within joints.
- E. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws; and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance:
1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
 2. Stainless Steel: Use stainless-steel fasteners.
- F. Seal joints as shown and as required with elastomeric sealant for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1-inch into sealant. Form joints to completely conceal sealant. When the ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants (for Roofing)."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder pre-painted metallic-coated steel sheet.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints where indicated and where necessary for strength.
- I. Protect all membrane penetrations as indicated and as recommended in SMACNA and NRCA manuals.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install starter and edge strips, and cleats before starting installation.
 - 2. Strip in all sheet metal flanges the same day they are installed.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces specified in Part 1 and as indicated.
 - 1. Backer Plates: Secure with fasteners suitable for substrate, 6-inches o.c. each face.
 - 2. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 12-inch centers.
 - 3. Apply 1/4-inch bead of sealant between each layer of metal at each edge.
 - 4. Cover Plates: Hook front or exposed face of cover plate over drip edge.
 - 5. Do not use mastic between sheet metal components.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4-inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4-inches over base flashing. Lap counterflashing joints a minimum of 4-inches and bed with elastomeric sealant.
 - 1. Sawcut new reglets where required.
 - a. Provide bayonet style lap joints, minimum 4-inch overlap.
 - b. Fill voids between wedges with backer rod.
 - c. Seal receiver to vertical face of wall.
 - 2. Secure in a waterproof manner by means of snap-in installation and sealant or plastic wedges and sealant.
 - 3. Install surface mounted reglets true to lines and levels.
 - a. Seal top of reglets with sealant.
 - b. Secure in place with neoprene head screws at maximum 12-inches on center.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
 - 1. Install lead flashings at all soil pipe penetrations. Turn lead flashing down inside piping, being careful not to block vent piping with flashing.
 - 2. Provide Penetration Seal System at all small penetrations not otherwise detailed.

- a. Clean roof surfaces to receive Penetration Seal Systems.
 - b. Clean pipes and penetrating elements to remove plastic cement, bitumen, and other contaminants by wire brushing and scraping.
 - c. Caulk around penetrating elements with curb adhesive.
 - d. Apply beads of curb adhesive to flat side of first precast curb component. Place caulked curb onto roof surface to form half circle around penetrating element.
 - e. Apply beads of curb adhesive to flat side and to scarf joints of second precast curb component. Place second section of curb onto roof surface to form circle with first section. Press scarf joints together firmly and press both sections down.
 - f. Apply continuous bead of curb adhesive around outside edge of curb at roof.
 - g. Fill around penetrating element with pourable sealant to top of curb.
 3. Pitch pans are not desired. Install only where specifically indicated or approved by Architect. Provide flanged umbrellas at all pitch pans.
 - a. Fill with non-shrink grout to 1-inch from top of flange.
 - b. Top with Pitch Pan Filler - Sealant Type ES-2.
 4. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.
- F. Protect all membrane penetrations as indicated and as recommended in SMACNA and NRCA manuals.

3.5 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On

completion of installation, remove unused materials and clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.8 SCHEDULE - MATERIALS

- A. Exposed to View Components:
 - 1. One-Piece Flashing and Expansion Joint Terminations: Stainless Steel Sheet.
 - 2. All Other Components: Stainless Steel Sheet.
- B. Concealed from View Components, (Counterflashings, Expansion Joint Covers, Etc.): Stainless steel sheet.
- C. Roof Penetration Flashings: Stainless steel sheet.
- D. Rain Hoods and Umbrellas: Stainless steel sheet.

END OF SECTION 07 62 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

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. Furnish all labor, materials, tools, equipment and related items required for the complete installation of firestopping at penetrations through rated partitions and floors.

- B. Related Sections:

- 1. Division 03 Section "Concrete" for floor penetrations.
 - 2. Division 07 Section "Thermal Insulation."
 - 3. Division 07 Section "Joint Sealants."
 - 4. Division 09 Section "Gypsum Board Assemblies."
 - 5. Divisions 21, 22, 23, and 26 for coordination with fire suppression, plumbing, HVAC and electrical work.

1.3 REFERENCES

- A. General:

- 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

- B. ASTM International:

- 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

- 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- 3. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems
- C. BAAQMD Regulation 8-51 - Adhesive and Sealant Products.
- D. Federal Specification HH-I-521F - Insulation Blankets, Thermal (Mineral Fiber, for Ambient Temperature).
- E. NEC - National Electrical Code.
- F. NFPA 70.
- G. UL Fire Resistance Directory.
 - 1. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SYSTEM DESCRIPTION

- A. Specified firestopping systems are based on a solid sealant only, or combinations of solid sealant, foam sealant, and refractory fibers of thickness required to attain hour ratings.
- B. Systems shall:
 - 1. Provide a flexible seal to prevent passage of fire, smoke, toxic gases and water through openings, and prevent transmission of sound and vibration from the penetrating element to the structure.
 - 2. Provide hour ratings indicated and in accordance with ASTM E 814 or UL 1479.
 - 3. Comply with requirements of CBC Sections 709.6, 709.7, 709.8, 710.2, 710.3 and 710.6, and CBC Standards 7-1 and 7-5.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01 Section "General Requirements."
- B. Product Data: Manufacturer's specifications, product data, material safety data sheets, and installation instructions for each type of installation required, listing specific materials proposed.
- C. Shop Drawings: Manufacturer's detail drawings and applicable UL system numbers for firestop systems to be installed.
- D. Samples: Samples of each item when requested by Project Manager.

- E. Manufacturer's Recommendations: Manufacturer's written recommendations for installations or configurations not covered by a UL-listed firestop system.
- F. Test Reports: Manufacturer's published test reports. Include manufacturer's system number and UL listing for each type of penetration.
- G. Certification: Manufacturer's written certification that firestopping system(s) furnished comply with UL system requirements, are approved for each specific condition of use on the Project.
- H. Closeout Submittals:
 - 1. Sealant and adhesive quantity use in accordance with requirements of BAAQMD Regulation 8-51.
 - 2. Written guarantee.

1.6 QUALITY ASSURANCE

- A. Firestopping systems shall be the products of one manufacturer Coordinate the work of the trades toward achieving this end.
- B. Installer Qualifications: Firm experienced in installation or application of systems similar in complexity to those required by this Project, and acceptable to or licensed by the product manufacturer.
- C. Regulatory Requirements:
 - 1. Comply with the requirements of Bay Area Air Quality Management District Regulation 8-51.
 - 2. Products shall be 100% asbestos and PCB free.
- D. Mock-Ups: Seal one wall opening as directed and under firestopping manufacturer's supervision, to show complete system and to verify installation methods and procedures.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver firestopping materials to job site in factory sealed, unopened containers bearing manufacturer's name, brand, product designation, batch number and packaging date.
- B. Store in unopened containers. Follow manufacturer's recommendations for storage temperatures and shelf life.
- C. Follow manufacturer's recommendations for handling products containing toxic materials. Use recommended solvents and cleaning agents for cleaning tools, equipment and skin.

1.8 PROJECT CONDITIONS

A. Environmental Requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

B. Existing Conditions: Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of substrates have been completed and supporting brackets installed.

1.9 GUARANTEE

- ### A.
- Written guarantee agreeing to repair or replace firestopping which fails in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability, or appears to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- ### A.
- Manufacturers: 3M, Hilti, Nelson, or as otherwise specified.
- ### B.
- Established Standard: Unless otherwise specified, 3M products are specified to establish standards and type of materials required. Approved, equivalent products of manufacturers specified above are acceptable.

2.2 MATERIALS

- ### A.
- Sealant: Select among the following materials as appropriate.
1. Solid (Elastomeric): 3M Fire Barrier Premium Latex CP 25WB+ Caulk, one-component elastomeric water-based latex sealant designed for use as a through-penetration firestop.
 2. Foam: 3M Fire Barrier 2001 Silicone RTV Foam, two-component silicone elastomer foam-in-place sealant designed to fill irregular or complex voids.

3. Wrap Strip: 3M Fire Barrier FS-195+ Wrap Strip, fire resistive strip designed to be wrapped around the penetrating item and secured in place.
 4. Restricting Collar: 3M Fire Barrier RC-1 Restricting Collar, sheet metal, designed for use with wrap strip in combustible through-wall firestop penetration systems.
 5. Composite Sheet: 3M Fire Barrier CS-195+ Composite Sheet, elastomeric layer reinforced with mesh restraining wire and covered with aluminum foil on one side and bonded to sheet metal, forming a fire resistive sheet.
 6. Putty: 3M Fire Barrier MP Moldable Putty+ Pads and Sticks, one-component elastomeric formable putty, designed for use as a through-penetration firestop system.
 7. Spray: 3M FireDam Spray 100, flexible water-based coating.
 8. Primers: As recommended by sealant manufacturer.
- B. Pillows: Nelson PLW Firestop Pillow, Hilti FS Fire Block, dust proof chemical resistant cloth with heat-reactive expanding solidifying fill, designed for large openings that require frequent cable alterations.
- C. Safing Insulation: USG "Thermafiber Safing Insulation", 4 lb density mineral wool insulation unless indicated otherwise.
- D. Damming Materials: As recommended by firestop manufacturer.

PART 3 - EXECUTION

3.1 CONDITION OF SURFACES

- A. Inspect surfaces to receive firestopping materials and report any defects to Project Manager. Do not start work until defects have been corrected. Starting work implies acceptance of surfaces as satisfactory.
- B. Unless otherwise permitted by manufacturer, do not apply firestopping materials to polycarbonates; materials that bleed oils, plasticizers or solvents; organo-metallic compounds; silicone rubber containing organo-tin compound; sulfur, polysulfides, polysulfones and other sulfur containing materials; amines, urethanes and amine-containing materials; and unsaturated hydrocarbon plasticizers.
- C. Do not apply materials in confined spaces where material is not exposed to atmospheric moisture.

3.2 PREPARATION

- A. Thoroughly clean surfaces and spaces to receive firestopping materials, removing foreign matter such as dirt, dust, moisture, rust, laitance, mill scale, oil, paint, lacquer, form coatings, water repellents and protective coatings.
- B. Do not use cleaning solvents which leave residue. Wipe joints free of solvent using clean, dry white cloths or white lintless paper. Do not use alcohol or alcohol-based materials. Do not permit solvent to air dry. Do not use detergents or soap and water solutions for cleaning unless specifically recommended by the sealant manufacturer.
- C. Follow manufacturer's directions for specific products and surfaces.

3.3 MIXING

- A. Job mix foam sealants in accordance with manufacturer's directions using approved equipment.
- B. Stir separate parts of multi-component sealants until settled fillers and pigments and any surface liquid are thoroughly dispersed.
- C. Combine separate parts in accordance with mixing instructions.

3.4 INSTALLATION

- A. Install systems in accordance with UL systems, and manufacturer's specifications and recommendations, using approved equipment and so as to achieve the required fire rating.
- B. Surface Preparation: Prepare surfaces as recommended by manufacturer immediately prior to installation of firestopping materials. If primers are used, make preliminary tests to ensure that primers will not stain exposed materials.
- C. Masking: Mask surrounding areas where necessary to prevent stains on exposed finished surfaces. Do not apply masking to surfaces which are to receive sealant materials. Remove masking immediately following completion of sealant work.
- D. Damming: Form leakproof dams as required to seal openings and contain sealant materials until cure is complete. Follow sealant manufacturer's recommendations.
- E. Sealing:
 - 1. Solid Sealant: For small spaces and where exposed to view in wall face. Immediately tool completed seal to slightly concave surface using recommended tooling agent.
 - 2. Foam:

- a. Use automatic metering, mixing, and dispensing equipment for large volume applications; factory prepared cartridges may be used for small volumes.
 - b. In general, use foam sealant for all applications except where solid sealant is permitted.
 - c. When sealant has cured, neatly trim excess where exposed to view.
3. Spray: Install in accordance with manufacturer's recommendations and requirements for specific use.

3.5 FIELD QUALITY CONTROL

- A. Perform manufacturer's quality control check program at least once daily and upon changing to new lot of materials.
- B. Inspect cured seals after 24 hours by removing damming materials to examine seals. Replace dams where a required part of assembly.
- C. Where voids occur, fill with freshly mixed foam or solid sealant. Reinspect after added material has cured 24 hours.
- D. Ensure that cured foam sealants show acceptable or better color and cell structure range per manufacturer's recommendations.
- E. Remove unacceptable sealants and replace with new.

3.6 CLEANING

- A. Clean adjacent surfaces soiled by firestopping work.

3.7 SCHEDULE

- A. Area and Occupancy Separation Walls: Partitions and rating requirements for rated walls are shown on the Life Safety Plan sheets of the Drawings. Wall partition construction is shown in the typical partition types.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sealants for the following applications, including those specified by reference to this Section:
- B. This Section includes sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between metal panels.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - e. Control and expansion joints in ceiling and overhead surfaces.
 - f. Other joints as indicated.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in brick pavers.
 - b. Control, expansion, and isolation joints in cast-in-place concrete slabs.
 - c. Joints between architectural precast concrete paving units.
 - d. Joints in stone paving units, including steps.
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - g. Other joints as indicated.
 - 3. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical control joints on exposed surfaces of interior unit masonry.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.

- g. Other joints as indicated.
 - 4. Interior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
- C. Related Sections include the following:
 - 1. Division 8, Section "Glazing" for glazing sealants.
 - 2. Division 9, Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
 - 3. Division 9, Section "Acoustical Tile Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.
 - 4. Division 32, Section "Concrete Paving" for expansion joints fillers and joint sealants

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in wide joints formed between two long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project

names and addresses, names and addresses of CORs and Governments, and other information specified.

- G. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- H. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Pre-construction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - a. Perform tests under environmental conditions replicating those that will exist during installation.
 - 2. Submit not fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 - 5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- E. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturers written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below.
 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Government of other rights Government may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.9 LEED REQUIREMENTS

- A. Indoor Environmental Quality Credit 4.1 – Low Emitting Materials: Adhesives and Sealants.

The VOC content of adhesives and sealants provided under this section must be less than the current VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168, and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51. This requirement shall take precedence over any potentially conflicting language in this specification. Products or manufacturers named in this specification may not be assumed to meet this requirement.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by COR from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Continuous-Immersion-Test-Response Characteristics: Where elastomeric sealants will be immersed continuously in water, provide products that have undergone testing according to ASTM C 1247, including initial six-week immersion period and additional immersion periods specified below, and have not failed in adhesion or cohesion when tested with substrates indicated for Project.
 - 1. One additional four-week immersion period.
 - 2. Two additional four-week immersion periods.
 - 3. Three additional four-week immersion periods.

- E. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.4 SOLVENT-RELEASE JOINT SEALANTS

- A. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.
- B. Butyl-Rubber-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1085 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.
- C. Pigmented Narrow Joint Sealant: For each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3 provide manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints or smaller in width.

2.5 LATEX JOINT SEALANTS

- A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.6 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and the following:
 - 1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.7 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 PRE-COMPRESSED SELF-EXPANDING SEALANT

- A. Palytite “B”, Palytite Manufacturing Corporation or approved equal.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface 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, grinding, blast cleaning, mechanical abrading, or a combination of these methods 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. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. 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.
- C. 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- G. Tooling of Non-sag 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. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 - 5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 random sample tests for each type of elastomeric sealant and joint substrate.
2. 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 long at sides of joint and meeting cross cut at one end. Place a mark from cross-cut end of piece.
 - b. Use fingers to grasp piece of sealant between cross-cut end and 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.
3. 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.
4. 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.

B. 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.

3.5 CLEANING

- #### A.
- Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- #### A.
- Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.7 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
 - a. 790; Dow Corning.
 - b. Silpruf; GE Silicones.
 - c. UltraPruf SCS2300; GE Silicones.
 - d. HiFlex 331; NUCO Industries, Inc.
 - e. NuFlex 309; NUCO Industries, Inc.
 - f. VP 275; Ohio Sealants, Inc.
 - g. 864; Pecora Corporation.
 - h. 890; Pecora Corporation.
 - i. PSI-641; Polymeric Systems, Inc.
 - j. Omniseal; Sonneborn Building Products Div., ChemRex Inc.
 - k. Spectrem 1; Tremco.
2. Type and Grade: S (single component) and NS (non-sag).
3. Class: 25.
4. Additional Movement Capability: 100 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (non-traffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Glass, aluminum.
7. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.

B. Multi-component Non-sag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
 - a. Vulkem 922; Mameco International.
 - b. Dynatrol II; Pecora Corporation.
 - c. Flexiprene 2000; Polymeric Systems, Inc.
 - d. Sikaflex - 2c NS; Sika Corporation.
 - e. DYmeric 511; Tremco.
 - f. Sonneborne: NP-1.

2. Type and Grade: M (multi-component) and NS (non-sag).
 3. Class: 25.
 4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
 5. Use Related to Exposure: NT (non-traffic).
 6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Ceramic tile and wood.
 7. Applications: Exterior expansion and control joints.
- C. Single-Component Pourable Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Available products include the following:
 - a. Chem-Calk 950; Bostik Inc.
 - b. Vulkem 45; Mameco International.
 - c. Vulkem Nova 300 SSL; Mameco International.
 - d. NR-201; Pecora Corporation.
 - e. Flexiprene PSI-951; Polymeric Systems, Inc.
 - f. SL 1; Sonneborn Building Products Div., ChemRex Inc.
 2. Type and Grade: S (single component) and P (pourable).
 3. Class: 25.
 4. Use Related to Exposure: T (traffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 6. Applications: Expansion and control joints at concrete paving.

3.8 SOLVENT-RELEASE JOINT-SEALANT SCHEDULE

- A. Butyl-Rubber-Based Solvent-Release Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Available products include the following:
 - a. Bostik 300; Bostik Inc.
 - b. PTI 707; H.B. Fuller Company.
 - c. PTI 757; H.B. Fuller Company.
 - d. NuFlex 232; NUCO Industries, Inc.
 - e. BC-158; Pecora Corporation.
 - f. PSI-301; Polymeric Systems, Inc.
 - g. Sonneborn Multi-Purpose Sealant; Sonneborn Building Products Div., ChemRex, Inc.
 - h. Tremco Butyl Sealant; Tremco.

3.9 LATEX JOINT-SEALANT SCHEDULE

- A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Available products include the following:
 - a. Chem-Calk 600; Bostik Inc.
 - b. NuFlex 330; NUCO Industries, Inc.
 - c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
 - d. AC-20; Pecora Corporation.
 - e. PSI-701; Polymeric Systems, Inc.
 - f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
 - g. Tremflex 834; Tremco.
 2. Applications: Interior gypsum board and painted surfaces.

3.10 PICK RESISTANT SECURITY SEALANT

- A. Pick-Resistant Security Sealant to be used in all secure areas.
1. Product: SB-190 Everseal manufactured by Surebond.www.surebond.com
 - a. Color: Clear.
 - b. Shore A Hardness Range: 70 to 80
 2. Applications: All secure Detention Areas.

3.11 ACOUSTICAL SEALANT

- A. Acoustical Sealant for use where sound transmission or noise reduction is required.
1. Product: Butyl or acrylic sealant; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
 2. Applications:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
 - b. Where indicated on Drawings for Noise Isolation Class rating for partitions and aluminum storefront systems.

3.12 PRE-COMPRESSED SELF-EXPANDING SEALANT

- A. Polyte Construction Products or equivalent. Polyte “B” in required widths for individual joint widths.

END OF SECTION 07 92 00

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

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. This Section includes hollow metal doors, frames, and borrowed lights as shown on the Drawings and Specifications herein.
- B. Related Sections include:
 - 1. Division 6 Section "Miscellaneous Rough Carpentry"
 - 2. Division 6 Section "Sheathing"
 - 3. Division 7 Section "Fluid-Applied Membrane Air Barrier System"
 - 4. Division 7 Section "Sheet Metal Flashing and Trim"
 - 5. Division 7 Section "Joint Sealants"
 - 6. Division 8 Section "Door Hardware"
 - 7. Division 8 Section "Glazing"
 - 8. Division 9 Section "Gypsum Board Assemblies"
 - 9. Division 9 Section "Painting"

1.3 QUALITY ASSURANCE

- A. Comply with ANSI/SDI 100 – Specifications for Standard Steel Doors and Frames.
- B. Design Criteria: Doors and frames noted to have a specific hourly label, shall be Underwriter's Laboratories, Inc. labeled construction shall bear the required UL label.

1.4 SUBMITTALS

- A. Division 01 Section – Submittal Procedures for submittals.
- B. Submit Product Data for each type of door and frame specified.

- C. Manufacturer shall furnish a certificate to the Owner evidencing that materials delivered meet the labeled and/or fire-resistive construction requirements.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Individually packaged in cartons, completely protecting frames.
- B. Frames shall be stored under cover on wood sills that will prevent rust and damage.

1.6 JOB CONDITIONS

- A. Coordination:
 - 1. The Contractor shall provide door and frame manufacturer with an approved hardware schedule, templates, and hand for all doors. Contractor shall advise door and frame manufacturer of any changes after information has been forwarded.
 - 2. Contractor will be completely responsible for coordination of information between hardware, door and frame manufacturer. Contractor shall coordinate throat dimensions and clearance at thresholds and sill conditions with adjacent construction. Any materials not properly coordinated shall be replaced by the Contractor at his own expense.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. Amweld Building Products, Inc.
 - 2. Ceco Door Products
 - 3. Curries Co.
 - 4. Pioneer Industries
 - 5. Republic Builders Products
 - 6. Steelcraft
 - 7. Armortex, Inc.
 - 8. Deansteel Manufacturing Company
 - 9. Or Equal.
- B. Hot-Rolled Steel Sheets: Commercial quality or drawing quality.
- C. Cold-Rolled Steel Sheets: Commercial quality or drawing quality.

- D. Galvanized Steel Sheets: Commercial quality or drawing quality, with coating designation mill phosphatized.
- E. Doors:
 - 1. Standard Steel Doors: Provide 1 ¾-inch thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedule.
 - a. Interior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 18-gauge cold-rolled steel sheet faces.
 - b. Exterior Doors: Grade III, extra heavy-duty, Model 2, seamless design, minimum 16-gauge galvanized steel sheet faces (G90). Windstorm approved.
 - 1) Core: Polystyrene with an R-value of not less than R-10 when calculated per ASTM C518.
 - 2. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 3. Templates are to be provided to the door manufacturer by the hardware contractor. Drilling and taping for surface mounted hardware shall be performed at the jobsite by the installing contractor. If bullet resistant transparent armor is required for the door vision panel, the vision panel shall be furnished by the door manufacturer and be UL Listed material of the same ballistic level as the door.
- F. Standard Type Frames: Provide 16 ga. frames for doors, sidelights, borrowed lights, and other openings that comply with ANSI/SDI 100; fabricate to be rigid, neat in appearance, and free from defects, warp, or buckle.
 - 1. For interior frames provide units with mitered or coped and continuously welded corners, formed from thick cold-rolled steel for openings or less in width and from thick steel for openings over in width.
 - 2. For exterior frames provide units with mitered or coped and continuously welded corners, formed from thick galvanized steel sheet. (G90)
 - 3. Door Silencers: 3 on strike jambs of single-door frames and 2 on heads of double-door frames.
 - 4. Plaster Guards: Provide where mortar might obstruct hardware operation and to close off interior of openings.
 - 5. Grout: As specified in Division 4 Section "Structural Reinforced Concrete Unit Masonry".
- G. Tolerances: Comply with SDI 117.
- H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

- I. Hardware preparation: Prepare doors and frames to receive mortised and concealed hardware according to SDI 107. Coordinate with Builders Hardware provider.
- J. Finishes, General: Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
 - 1. Apply primers and organic finishes to doors and frames after fabrication.
- K. Galvanized Steel Sheet Finishes: Comply with SDI 112 and the following:
 - 1. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified to comply with ASTM A 780.
 - 2. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight.
 - 3. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
 - a. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
 - 1. Exercise extreme care when installing door frames. All door frames which are installed out of plumb, distorted and not level or in a manner which does not permit proper installation of doors, must be removed and replaced with new frames in a manner satisfactory to the Architect.
- C. Install at least three (3) anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
- D. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

- E. All exterior door frames, and door frames at masonry construction partition walls, to be grouted solid.

3.2 PROTECTION AND CLEANING

- A. Protect metal doors and frames and their finishes from damage and detrimental soiling during the remainder of construction.
 - 1. Repair and repaint hollow metal that is damaged or soiled, to eliminate evidence of damage, in a manner acceptable to Architect. Replace components that cannot be repaired.
 - 2. Repair damaged prime coat per requirements of Section 09 91 00, "Painting". Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.
- C. Clean doors and frames prior to inspection for substantial completion. Touch-up paint finish as required. Clean with products that will not damage finishes.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Solid-core doors with factory finished flush wood-veneer faces, including fire rated doors.
 - 2. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 3. All wood doors to be provided with factory finish.
- B. Related Sections include the following:
 - 1. Division 8, Section "Hollow Metal Doors & Frames" for hollow metal doors for use with flush wood doors.
 - 2. Division 8, Section "Door Hardware" for hardware coordination.
 - 3. Division 8, Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire ratings for fire doors.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:

1. Faces of Factory-Finished Doors: Show the full range of colors available for stained and transparent finishes.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
3. Frames for light openings, long, for each material, type, and finish required.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated".
 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252, UBC Standard 7-2.
 1. Test Pressure: Positive pressure.
 2. See Drawings and Door Schedule for door fire rating requirements.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between and relative humidity between 43 and 70 percent during the remainder of the construction period.

1.7 WARRANTY

- A. Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup or twist) more than in a section, or show telegraphing of core construction in face veneers exceeding span.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flush Wood Doors:
 - a. Algoma Hardwoods Inc.
 - b. Ampco Products, Inc.
 - c. Buell Door Company.
 - d. Chappell Door Co.
 - e. Eagle Plywood & Door Manufacturing, Inc.
 - f. Eggers Industries; Architectural Door Division.
 - g. GRAHAM Manufacturing Corp.
 - h. Haley Brothers, Inc.
 - i. Ideal Wood Products, Inc.
 - j. IPIK Door Company.
 - k. Lambton Doors.
 - l. Marlite.
 - m. Mohawk Flush Doors, Inc.
 - n. Oshkosh Architectural Door Co.
 - o. Poncraft Door Co.
 - p. Southwood Door Co.

- q. Vancouver Door Company, Inc.
- r. VT Industries Inc.
- s. Weyerhaeuser Company.
- t. Or Equal.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Factory Applied Transparent Finish:

- 1. Grade: Premium, with Grade A faces.
- 2. Face Species: White oak.
- 3. Veneer Cut: Flat Cut.
- 4. Veneer Matching Type: Book match.
- 5. Assembly of Veneer Leaves on Door Faces: Book match.
- 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

2.3 SOLID-CORE DOORS

A. Particleboard Cores: Comply with the following requirements:

- 1. Particleboard: ANSI A208.1, Grade LD-1.
- 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch top-rail blocking, in doors indicated to have closers.
 - b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c. 5-inch mid-rail blocking, in doors indicated to have exit devices.
- 3. Provide doors with either glued-block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.

B. Interior Veneer-Faced Doors:

- 1. Core: Particleboard.
- 2. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:

- 1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
- 2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as follows:

- a. Top-rail blocking.
 - b. Bottom-rail blocking, in doors indicated to have protection plates.
 - c. Mid-rail blocking in doors indicated to have armor plates.
 - d. Lock blocks, mid-rail blocking, in doors indicated to have exit devices.
3. Intumescent Seals: Intumescent seals to be provided as an integral part of the door edge construction to comply with positive pressure requirements as required by applicable codes.
 4. Edge Construction (when required by applicable building code): Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.
 5. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:

1. Wood Species: Same species as door faces.
2. Profile: Provide stops flush with door faces.
3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.

2.5 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.

B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile to match door veneer finish.

2.6 FACTORY FINISHING

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Finish doors at factory.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: AWI System TR-11, catalyzed polyurethane.
 3. Staining: None Required.
 4. Effect: Open-grain finish.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08, Section "Door Hardware".
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide at heads, jambs, and between pairs of doors. Provide from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide from bottom of door to top of threshold.
 - a. Comply with NFPA 80 for fire-rated doors.
 2. Bevel non-fire-rated doors at lock and hinge edges.
 3. Bevel fire-rated doors at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

3.4 ACCESSARIES

A. VISION LITES WITH INTEGRAL MINIBLINDS

Provide factory-installed vision lite assemblies with integral miniblinds sealed between insulated glass units where indicated on Drawings or Door Schedule. Vision lites shall be suitable for installation in flush wood doors, including fire-rated assemblies where required.

1. Manufacturers: Activar Construction Products Group
2. Models: VSIGMB™ (Lowest Profile Beveled Vision Frame) or VLFEZIGMB™ (Beveled Vision Frame), or approved equal.
3. Frame Construction: 20-gauge cold-rolled steel vision frame with 1-1/4 inch beveled trim. Factory-applied finish selected by Architect from manufacturer's standard colors.
4. Glazing: 1-inch sealed insulated glass unit consisting of two panes of 1/8-inch clear tempered glass. Vision lite order size equals door opening cutout. Glass size shall be 1 inch smaller than order size.
5. Integral Miniblinds: White painted aluminum miniblinds, 5/8-inch slats, sealed between glass panes. Blinds shall tilt 180 degrees and be operated by a single magnet-controlled fingertip operator for raise, lower, and tilt functions. Provide privacy channels at both edges of blinds.
6. Sizes: Provide manufacturer's standard sizes unless otherwise indicated. Custom sizes subject to approval.
7. Fire-Rated Assemblies: Where installed in fire-rated doors, provide listed and labeled vision lite assemblies approved for required fire ratings and installed in accordance with NFPA 80.

8. Installation: Install vision lites in accordance with manufacturer's written instructions. Coordinate cutouts with door manufacturer to maintain door integrity and fire ratings.

END OF SECTION 08 14 16

SECTION 08 53 13 - VINYL WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Impact Resistant, Vinyl Fixed windows.
- B. Related Sections include the following:
 - 1. Division 6, Section "Miscellaneous Rough Carpentry."
 - 2. Division 6, Section "Sheathing."
 - 3. Division 7, Section "Fiber-Cement Siding."
 - 4. Division 7, Section "Fluid-Applied Membrane Air Barrier System."
 - 5. Division 7, Section "Sheet Metal Flashing & Trim."
 - 6. Division 7, Section "Joint Sealants."

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide vinyl windows capable of complying with performance requirements indicated based on testing manufacturer's windows that are representative of those specified and that are of minimum test size required by AAMA/NWWDA 101/I.S.2.
- B. Structural Performance: Provide vinyl windows capable of withstanding the following, including wind loads as indicated on the Structural Drawings based on ASCE 7-16, at basic wind speed indicated therein.
 - 1. Design Requirements: Impact Resistant Vinyl Fixed & Awning Windows, as part of a tested assembly, shall comply with the Performance Requirements of exterior wall openings as indicated in Section 01 41 00 - "Regulatory Requirements (Windstorm Construction Requirements)."
 - 2. Deflection: Based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Deflection Test or on glass framing system designed to limit lateral deflections of

glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on structural computations.

- C. Air Infiltration: Maximum rate not more than 0.06 cfm per foot of perimeter at 6.24 psf when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.
- D. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling 10 psf when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.

1.4 SUBMITTALS

- A. Performance Documentation: For vinyl windows, submit product documentation verifying that the product(s) submitted has been tested as a part of an assembly that meets the Performance Requirements for exterior wall openings as indicated in Section 01 41 00 - "Regulatory Requirements (Windstorm Construction Requirements).
- B. Product Data: For each type of vinyl window indicated. TDI windstorm pressures and missile impact resistance per section 01 33 00 1.4D
- C. Shop Drawings: Include plans, elevations, sections, connections, details, hardware, attachments to other Work, and operational clearances.
 - 1. Include structural analysis data indicating structural test pressures and design pressures from basic wind speeds indicated and deflection limitations of glass framing systems, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Engineering Calculation: Submit wind uplift pressure and connection calculations according to ASCE 7 wind speed for project location with respect to appropriate importance factor, exposure category and safety factor. Calculations shall be sealed by a professional engineer licensed to practice structural engineering in the state of Texas.
- D. Samples: For each exposed finish.
- E. Field quality-control test reports.
- F. Product test reports.
- G. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
- B. Fenestration Standard: Comply with AAMA/NWDA 101/I.S.2, "Voluntary Specifications for Vinyl, Vinyl (PVC) and Wood Windows and Glass Doors", for minimum standards of performance, materials, components, accessories and fabrication unless more stringent requirements are indicated.
- C. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.
- D. Mockups: Build mockups to demonstrate aesthetic effects.
 - 1. Perform tests specified in "Field Quality Control" Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
 - 2. Approved mockups may become part of the completed Work, if approved in writing by Architect.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vinyl windows which fail in materials and workmanship within two years from date of Substantial Completion.
- B. Warranty Period for Glass: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide PGT Industries, PW-5520 Series, Vinyl Fixed Windows - Impact Resistant, or a comparable provided by one of the following:
 - 1. Wincore Window Company, LLC.
 - 2. CGI Windows and Doors, Inc.
 - 3. Alternate manufacturers and systems submitted as equals must be approved in writing by the Architect prior to Project bid date.

- B. Basis-of-Design: Subject to compliance with requirements, provide PGT Industries, AW-5540 Series, Vinyl Awning Windows - Impact Resistant, or a comparable provided by one of the following:
 - 1. Wincore Window Company, LLC.
 - 2. CGI Windows and Doors, Inc.
 - 3. Custom Window Systems.
 - 4. Alternate manufacturers and systems submitted as equals must be approved in writing by the Architect prior to Project bid date
- C. Sizes: As indicated on the Drawings.
- D. Power Operated Actuators: Provide actuator on windows where indicated on Drawings. Basis-of-Design: Subject to compliance with requirements, provide Window Master International, Model WMX 804, window actuators, or a equivalent product.

2.2 GLAZING

- A. Glass and Glazing Materials: As selected from manufacturer's full range of glazing products tested as part of the approved window system meeting the performance requirements.
- B. **Glazing:** Clear, insulated, argon-filled, low-E
- C. **Maximum U-factor:** 0.30
- D. **Maximum SHGC:** 0.25
- E. **Air Leakage:** ≤ 0.3 cfm/ft² at 6.24 psf (ASTM E283)
- F. **Installation:** Per manufacturer instructions; seal, flash, and integrate with air barrier to maintain IECC compliance

2.3 FABRICATION

- A. General: Fabricate vinyl windows, in sizes indicated. Windows shall be fabricated from high impact UPVC (Unplasticized Polyvinyl Chloride) Windows shall comply with requirements and that meet or exceed AAMA/NWWDA 101/I.S.2 performance requirements for the following window type and performance class. Include a complete system for assembling components and anchoring windows.
- B. Fabricate vinyl windows that are re-glazable without dismantling sash or ventilator framing.
- C. All joints shall be mitered and continuously welded.

- D. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.4 FINISHES

- A. Vinyl Finish: To be chosen by Architect from manufacturer's full range of colors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Vinyl window systems shall be installed and completed with perimeter flashing in-place and complete for Architect's review and approval prior to installation of adjoining exterior wall finished (i.e.: Fiber Cement Siding).
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for the presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- F. Clean surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Clean factory-glazed glass immediately after installing windows. Comply with manufacturers written recommendations for final cleaning and maintenance. Remove non-permanent labels and clean surfaces.
- H. Remove and replace glass that has been broken, chipped, cracked, abraded or damaged during construction period.

3.2 FIELD QUALITY CONTROL

- A. Remove and replace windows where test results indicate that they do not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 08 53 13

SECTION 08 71 00 - DOOR HARDWARE

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. Complete hardware for flush wood and hollow metal doors. Select builder's hardware for aluminum storefront doors and entrances & acoustical door & frame assemblies.
- B. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
- C. Related Requirements:
 - 1. Section 08 11 13, "Hollow Metal Doors and Frames."
 - 2. Section 08 14 16, "Flush Wood Doors."

1.3 COORDINATION

- A. Installation Templates: Distribute doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
- B. Keying Conference: Conduct conference at Project site.
- C. Conference participants shall include Architectural Hardware Consultant and Owner's Representative.
 - 1. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish as required.
- E. Samples for Verification: For each type of exposed product, in each finish specified as required.
 - 1. Sample Size: Full-size units or minimum 2-by-4-inch for other products.

- a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
 2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of Certified Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use scheduling sequence and vertical format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant, as required by architect.

- B. Product Certificates: For each type of electrified door hardware.
 - 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.8 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. Door Hardware:
 - a. Two (2) each Exit Devices: 11-21-43-AD8513-ETL 32D
 - b. Two (2) each Locksets: 28 64 10G37 LL US26D

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: One year from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic Locks & Exit Devices: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the "2012 Texas Accessibility Standards," and Technical Memorandum.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled in Part 3.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. McKinney Manufacturing – Basis of Design.
 - 2. Hagar Companies.
 - 3. Ives.
 - 4. Stanley Commercial products.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated in hardware sets.
 - 2. Levers: Cast.
 - 3. Roses: Wrought.
 - 4. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 - 1. Sargent Manufacturing - Basis of Design.
 - 2. Schlage.
 - 3. Yale.

- G. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

- 1. Sargent Manufacturing - Basis of Design.
- 2. Schlage.
- 3. Yale.

2.6 AUXILIARY LOCKS

- A. Bored Auxiliary Locks: BHMA A156.36: Grade 1; with strike that suits frame.

- 1. Sargent Manufacturing - Basis of Design.
- 2. Schlage.
- 3. Yale.

2.7 ELECTROMECHANICAL LOCKS

- A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; with strike that suits frame.

- 1. Sargent Manufacturing - Basis of Design.
- 2. Schlage.
- 3. Yale.

2.8 SURFACE BOLTS

- A. Surface Bolts: BHMA A156.16.

- 1. Rockwood Manufacturing – Basis of design.
- 2. Hagar Companies.
- 3. Ives.

2.9 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

- 1. Rockwood Manufacturing – Basis of Design.
- 2. Hagar Companies.
- 3. Ives.

2.10 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Sargent Manufacturing - Basis of Design.
2. Schlage.
3. Von Duprin.

2.11 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Sargent Manufacturing - Basis of Design.
2. Schlage.
3. Yale.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Removable.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders. Or as determined in keying meeting.
 - a. Provide three-cylinder change keys and five each of master and grand master keys.
2. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

2.13 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
 1. Lund Key Cabinet
 2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock. Double tag system
- B. Key Lock Boxes: Designed for storage of # of keys as required by local fire department.
 1. Knox Box Recessed with hinged door location as required by fire department. Finish as selected by architect.

2.14 ACCESSORIES FOR PAIRS OF DOORS

- A. Astragals: BHMA A156.22.

2.15 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 1. Sargent Manufacturing - Basis of design.
 2. LCN.
 3. Norton Door Control.

2.16 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.
 1. ABH Manufacturing – Basis of design

2.17 ELECTRIC STRIKES

A. Electrified Locking Devices: BHMA A156.25.

1. Folger Adams - Basis of Design.

2.18 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Rockwood manufacturing – Basis of Design
2. ABH Manufacturing
3. Glynn Johnson.

2.19 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. National Guard products – Basis of design.
2. Pemko Manufacturing.
3. Zero International.

2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from - 0.050-inch thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Rockwood Manufacturing – Basis of design
2. Hagar Companies.
3. Ives.

2.21 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for

every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control System:
 - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
- F. Boxed Power Supplies: Locate power supplies as indicated. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately Three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 EXISTING DOOR FRAMES

- A. Where existing frames are scheduled to remain, coordinate new door hardware with existing hardware locations of hinges, strikes, etc. where possible and modify frames as necessary to accommodate new hardware.
- B. All existing frames indicated to remain will have all abandon openings, holes, and defects repaired prior to refinishing.

HARDWARE SCHEDULE:

See hardware on drawing schedule sheet A801.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Vinyl windows impact rated insulated glass.
 - 2. Exterior hollow metal door lights (impact resistant)
 - 3. Interior borrowed lights.
 - 4. Silvered plate glass mirror & mounting hardware.
- B. Related Sections include the following:
 - 1. Division 08 Section "Hollow Metal Doors."
 - 2. Division 08 Section "Flush Wood Doors."

1.3 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
- D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written

instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated. TDI windstorm pressures and missile impact resistant per section 01 33 00 1.4D
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass and of 12-inch- long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- C. Samples: For the following products, in the form of 12-inch- square Samples for glass.
 - 1. Each type of glass scheduled and/or required.
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- G. Pre-construction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- H. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:
 - 1. All scheduled glass types.
 - 2. Glazing sealants.
 - 3. Glazing gaskets.
- I. SWRI Validation Certificate: For each elastomeric glazing sealant specified to be validated by SWRI's Sealant Validation Program.
- J. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

- A. Glass fabricator to have 10 years of experience and meet ANSI / ASQC Q9002 1994.
- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- C. Single Source fabrication responsibility: Fabrication processes, including Low E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single Fabricator.
- D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
- E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
 - 1. Refer to the following sections for compliance with impact resistant requirements:
 - a. Specification Section 08 41 13 - Aluminum-Framed Entrances and Storefronts

- F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Refer to the following sections for compliance with impact resistant requirements:
 - a. Specification Section 08 41 13 - Aluminum-Framed Entrances and Storefronts
- G. Pre-construction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glass type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants.
 - 1. Refer to the following sections for compliance with impact resistant requirements:
 - a. Specification Section 08 41 13 - Aluminum-Framed Entrances and Storefronts
- H. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- I. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
 - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
 - 1. Insulating Glass Certification Council.
- K. Mockups: Each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Coordinate with Specification Sections 08 41 13 – Aluminum-Framed Entrances and Storefronts.
 - 2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.

- a. All impact resistant glass types.
 3. Notify the Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting fabrication.
 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- L. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section 01 31 00 - "Project Management and Coordination".
1. Coordinate with Specification Sections 08 41 13 – Aluminum-Framed Entrances and Storefronts.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.10 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: Five years from date of Substantial Completion.

- C. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Twenty (20) years from date of Substantial Completion.
- D. Provide a written 5-year warranty from date of manufacture for ceramic frit. Warranty covers deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Guardian Industries Corp.; SunGuard.
 - 2. Oldcastle BuildingEnvelope™.
 - 3. Pilkington North America.
 - 4. Viracon, Inc.
 - 5. PPG Ideascapes Solarban.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 - 1. Obtain tinted glass from single source from single manufacturer.
 - 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide

glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses for Interior Applications: Select minimum glass thicknesses to comply with ASTM E 1300 and shall meet all applicable code requirements.
 2. Glass Thicknesses for Exterior Applications: Exterior glass includes insulated and non-insulated impact resistant glazing. Glass thickness shall be as required to meet the Texas Department of Insurance requirements as such.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings. (Refer Drawing Sheet S-0.1).
 2. All exterior glazing locations shall comply with Texas Department of Insurance requirements for large missile impact resistance in conjunction with other Specification Sections.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. Center-of-glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 5.2 computer program, expressed as BTU/sq ft x h x deg F (W/sq. m x K).
 2. Center-of-glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 5.2 computer program.
 3. Solar Optical Properties: NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- E. Reflective-Coated Vision Glass: ASTM C 1376.
- F. Reflective-Coated Spandrel Glass: ASTM C 1376, Kind CS.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
1. Polyvinyl butyral (PVB) interlayer.
- C. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets as follows:
1. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.

2.6 INSULATING GLASS (IMPACT RESISTANT)

- A. Insulating-Glass Units: Pre-assembled units consisting of sealed lites of glass separated by a dehydrated interspace and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in the Insulating-Glass Schedule at the end of Part 3.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
- B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
- C. Sealing System: Dual seal, with primary and secondary sealants as follows:
1. Manufacturer's standard sealants to meet or exceed twenty (20) year warranty requirements.
- D. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
1. Aluminum with black color-anodized finish.

2.7 MIRRORED GLASS

- A. Silvered Mirrored Glass: Annealed clear float glass with successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer's standard organic protective coating applied to second glass surface to produce a coating system complying with FS DD-M-411.
 - 1. Mounting: See wall drawings for wall mounted mirror locations & sizes. Provide all mounting hardware & adhesive. Grind / polish exposed mirror edges.

2.8 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: Black.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant for each type of glazing condition.

2.9 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
 - 1. For exterior impact resistant assemblies, provide type and material required based on impact resistant testing and certification criteria.

2.10 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.11 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.
- C. Grind smooth and polish exposed glass edges.

2.12 MISCELLANEOUS MIRROR MATERIALS

- A. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 - 1. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Mounting Accessories: Brushed stainless steel (Type 302) mirror clips similar to KV277 at bottom and KV278 at top in number as required to accommodate size of mirror.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members to receive glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by pre-construction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past the face of glazing stops.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

- C. Comply with application requirements for impact resistant assembly.
- D. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.7 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove non-permanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.8 GLAZING SCHEDULE

- A. Basis of Design products are indicated in the Glass Types of this section, or equal as approved by Architect.
- B. PPG impact rated glass insulated glass ()
- C. TYPE 1: 9/16" thick, Clear laminated, impact resistant, monolithic glazing; VIRACON, INC. (at exterior storefront entrance doors).
 - 1. Outside Pane: 1/4" thick, Clear heat strengthened.
 - 2. Interlayer: 0.090" clear PVB layer.
 - 3. Inside Pane: 1/4" thick, Clear heat strengthened.

- 4. Visible Light Transmittance: 46%
 - 5. Winter Nighttime U-Value: .29.
 - 6. Solar Heat Gain Coefficient (SHGC): .25.
- D. TYPE 2: Mirror, unframed; 1/4" thickness with rounded, polished edges.
- E. TYPE 3: 1/4" thick, Clear laminated, safety glass (at interior borrowed lites, door vision panels, and transoms).

END OF SECTION 08 80 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Provide gypsum drywall as shown on the drawings and as herein specified including but not limited to: Metal stud framing, suspended ceiling systems, gypsum drywall and finishing systems.
- B. Related Sections include the following:
 - 1. Division 5, Section "Cold Formed Metal Framing."
 - 2. Division 6, Section "Miscellaneous Rough Carpentry."
 - 3. Division 6, Section "Interior Architectural Woodwork", for coordination of metal framed cabinet supports.
 - 4. Division 7, Section "Thermal Insulation."
 - 5. Division 7, for additional requirements for fire stopping and sealants installed with gypsum board assemblies.
 - 6. Division 9, Section "Acoustical Insulation."
 - 7. Division 9, Section "Painting."
 - 8. Division 9, Sections, for coordination of tiling, wall base materials, and other finishes applied to gypsum board assemblies.
 - 9. Divisions 10 and 11, and other Sections as applicable, for coordination of accessories and equipment requiring blocking in walls.

1.3 SUBMITTALS

- A. Certificate: Furnish certificate evidencing that material meets or exceeds specification and fire rating requirement.
- B. Samples: Textured panels, approximately 12" square for each interior paint color indicated.
- C. Informational Submittals:

1. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - a. Evaluation reports certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

1.4 QUALITY ASSURANCE

- A. Metal Support Standard: ASTM C 754.
- B. Metal Stud Standard: ASTM C 645.
- C. Gypsum Board Standard: GA 216 by Gypsum Association.
- D. Tolerances: 1/8" Offsets between planes of board faces and 1/4" in 8'-0" for plumb, level, warp and bow.
- E. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.
 1. Install mockups for the following applications:
 - a. Surfaces indicated to receive nontextured paint finishes.
 2. Simulate finished lighting conditions for review of mockups.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PERFORMANCE / DESIGN CRITERIA

- A. Acoustic Ratings: Construct assemblies to achieve acoustic ratings indicated on Drawings, assemblies tested to ASTM E90 and classified in accordance with ASTM E 413 by an independent testing agency.
- B. Deflection Limits:
 1. Limit deflection of partitions to following limits, based on design load.
 - a. Partitions to receive tile, plaster, adhered stone, or similar heavy finish materials: L/360.
 - b. Other partitions: L/360.
 - c. Comply with minimum stud gauges required elsewhere in these specifications, the most stringent requirement shall prevail. If partition height exceeds stud manufacturer's limiting height for applicable loading and

deflection, install bracing above ceiling, decrease stud spacing, or increase stud gauge.

d. Limit deflection of ceilings to $L/360$.

C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by, and displaying a classification label from, an independent testing agency acceptable to the authority having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
2. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with applicable and referenced UL design numbers.
3. In the event that requirements of assembly numbers referenced conflict with other Contract Document requirements, conform to assembly requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials with manufacturer's label attached. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging. Protect materials from dampness or wetting. Remove any damaged materials.
- B. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. Clark Dietrich Building Systems.
 - b. Marino|WARE
 - c. SCAFCO Corp.
 - d. Or Approved Equal.
 - 2. Gypsum Board and Related Products:
 - a. Georgia-Pacific Gypsum Corp.
 - b. United States Gypsum Co. (USG)
 - c. Or Approved Equal.
- B. Source Limitations:
 - 1. Provide framing materials and accessories used on the project by one manufacturer throughout.
 - 2. Provide wall board materials of each type and accessories used on the project by one manufacturer throughout.

2.2 FRAMING MATERIALS AND ACCESSORIES

- A. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M:
 - a. Protective Coating: ASTM A 653/A 653M, G60 (Z180).
- B. Metal Framing: Provide light gauge metal framing and accessories supplied by one manufacturer throughout. Provide standard gauges of galvanized steel channel studs at size and spacing indicated on drawings, and as follows:
 - 1. Minimum 18-gauge studs where distance between intersecting horizontal bracing wall is greater than 12'-0".
 - 2. Minimum 16-gauge studs where distance between intersecting horizontal bracing wall is greater than 18'-0".
 - 3. Minimum 20-gauge studs where greater gauge is not otherwise required.

4. Depths: As indicated in Drawings.
- C. Runner Tracks: ASTM C645. Standard with manufacturer for type and size stud utilized, same finish. Furnish all necessary miscellaneous accessories such as clips, brackets, etc.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track, including "angled or pitched" track where necessary; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dietrich Metal Framing; MaxTrak or BlazeFrame Slotted Deflection Track.
 - b. MBA Building Supplies; Slotted Deflection Track.
 - c. Steel Network Inc. (The); VertiTrack VTD Series.
 - d. Or approved equal.
- E. Firestop Tracks: Utilize Firestop track at fire rated walls as tested in U. L. assemblies for head of wall joint. Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dietrich Metal Framing; MaxTrak or BlazeFrame Slotted Deflection Track.
 - b. Metal-Lite, Inc.; The System.
 - c. Or approved equal.
- F. Flexible Track: Equal to Clark-Dietrich "Contour Track," segmented flexible track for smoothly forming non-structural framing to curves and radii indicated.
- G. Stud Spacer bars: Equal to Clark-Dietrich "Spazzer 9200," 7/8" x 7/8" x 50" long right-angle bar pre-notched 16" and 24" centers. (20 gauge.)
- H. Cold Rolled Furring Channels: Depths as indicated on Drawings, 16-gauge steel channels with minimum 1/2" wide flanges.
- I. Hat Shape Furring Channels: ASTM C 645, 7/8" x 1-1/4", unless otherwise indicated on Drawings, minimum 20-gauge, galvanized steel hat shaped sections.
- J. Resilient Furring Channels: 1/2" deep steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.
- K. Z-Shaped Furring Channels: Non-slotted web, face flange of 1-1/4", and wall attachment flange of 7/8". Minimum 20-gauge galvanized steel, or heavier where required by weight of and deflection limits for attached finish systems. Size: As indicated in Drawings.
1. Provide J or C shaped track and channels with non-slotted web to frame around openings where required and where indicated in Drawings for fire rated construction and / or for screw attachment or support of windows. 16 gauge where required to prevent flame spread at cavity wall construction.
- L. Slide Clips: Provide minimum 600-pound lateral capacity design load thickness, or as shown on drawings. Provide prefabricated clips as manufactured by Clark Dietrich Framing Systems, or equal. Install as shown on drawings.
- M. Framed openings: Equal to Clark-Dietrich "RedHeader Pro," Galvanized steel one piece header and jamb studs meeting or exceeding the requirements of ASTM C 754.
- N. Blocking and Backing Plates: Refer to Division 06, Section "Rough Carpentry". At Contractor's option, the following blocking types may be provided in lieu of fire rated wood blocking, provided that the material will meet the most stringent strength requirements for each item to be attached to such blocking.
1. Proprietary fire-resistance-treated blocking and bracing in width indicated.
 2. Minimum 16-gauge, galvanized sheet steel backing plates.
- O. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- P. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated on the Drawings.
1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

2.3 GYPSUM WALLBOARD PANELS

- A. General: Specifications based on materials and manufacturers listed are to set quality standard. Subject to compliance with requirements, provide the named products, or comparable products by another manufacturer.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- C. Gypsum Wallboard: ASTM C 1396 unless otherwise indicated.

- a. Products: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensArmor Plus® Abuse-Resistant FireCore®, or approved equal.
- b. Face: Glass-Mat
- c. Core: 5/8", Type X.
- d. Surface Abrasion: Meets or exceeds Level 3 requirements.
- e. Surface Indentation: Meets or exceeds Level 1 requirements.
- f. Single-Drop Soft-Body Impact: Meets or exceeds Level 1 requirements.
- g. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- h. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- i. Locations: Everywhere gypsum board is called out on drawings.

2.4 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325.
 - 1. Products: Subject to compliance with requirements, provide one of the following or other approved equal:
 - a. Custom Building Products; Wonderboard.
 - b. United States Gypsum Co.; DUROCK Cement Board.
 - 2. Thickness: As indicated.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbeads: Equal to Clark-Dietrich "103 Deluxe." Use at outside corners.
 - b. Metal Edge Trim: Standard trim of galvanized steel with either knurled and perforated or expanded flanges and beaded for concealment of flange in joint compound. Equal to Clark-Dietrich "200 or 400 Series." Apply where board abuts or terminates at another material.
 - 1) L-Bead: L-shaped; exposed long flange receives joint compound; use at exposed panel edges.
 - 2) J-Mold: Metal J-molds; exposed flange receives joint compound, use at all panel edges abutting dissimilar materials.

- c. Gypsum Control Joints: Metal V-shape control joints. Use where indicated and at changes in backup material and in partitions at 30'-0" o.c. maximum, and at large gypsum board ceiling areas at 20'-0" o.c. maximum. Also provide at both sides all interior and exterior window & door frames.
- B. Aluminum Reveal Trim: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy T-5. Extruded accessories of profiles and dimensions where indicated in Drawings:
 - 1. Profiles: Provide trims equal to DA.1 as manufactured by Fry Reglet.
 - 2. Finish: Mill finish.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Only paper joint tape (no fiberglass tape) will be used.
 - a. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound, equal to USG Durabond 90.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound, equal to USG Durabond Joint Taping Compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound, equal to USG Ready Mixed Joint Topping.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by panel manufacturer.

2.7 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated into the work include the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 2. Acoustical foam sealant may be used to fill voids to decking or other similar conditions above ceilings.
- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Door frame Grout: Equal to USG Durabond 90 Joint Compound, Multi-Purpose.
- D. Hanger Wire: ASTM A 641, 9 Gauge galvanized steel wire.
- E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- F. Insulation:
1. Thermal Insulation: Refer to Division 07, Section "Thermal Insulation".
 2. Acoustical Insulation: Refer to Division 09, Section "Acoustical Insulation".
 3. Fire Resistant Assemblies: Provide mineral fiber insulation according to the requirements of the fire rated assembly, except where greater thickness is indicated for partitions that also carry an acoustical rating.

2.9 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
 - 1. Texture: Light sanded.
- C. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.
 - 1. Texture: Orange Peel.

2.10 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Cast-in-place anchor, designed for attachment to concrete forms or, postinstalled, expansion anchor.
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, unless otherwise indicated on Drawings, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm), unless indicated otherwise on the Drawings.
 - b. Depth: As indicated on the Drawings.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm), unless indicated otherwise on the Drawings.
 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.
 - d. Or approved equal.

2.11 ACCESS PANELS (GYPSUM BOARD CEILINGS)

A. Manufacturers: Subject to compliance with requirements, provide:

1. Basis of Design: Acudor Products; **UT-500 Universal Access Door**.
2. Or approved equal.

B. Description:

1. Flush access panel for installation in gypsum board ceiling systems.
2. Frame and door: Steel construction with concealed flange for tape-in gypsum board finish.
3. Door Style: Flush panel suitable for field finishing.

C. Size:

1. Nominal opening size: 30 inches by 30 inches.

D. Finish:

1. Factory prime coated.

2. Field paint to match adjacent ceiling finish.

E. Performance Requirements:

1. Provide units compatible with gypsum board ceiling construction indicated.
2. Provide access panels sized and located as required for access to above-ceiling equipment and spaces.

EXECUTION

A. Install access panels in gypsum board ceilings where indicated and where required for access to concealed items.

B. Coordinate locations with mechanical, electrical, and plumbing work to ensure full accessibility.

C. Install panels plumb, level, and flush with adjacent ceiling surfaces.

D. Tape and finish panel flange to match adjacent gypsum board ceiling finish.

E. Paint access panel door and frame to match adjacent ceiling.

PART 3 - EXECUTION

3.1 EXAMINATION AND COORDINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Interface and Coordination with Other Work:
 1. Coordinate installation of firestopping at penetrations through fire-resistive rated assemblies.
 2. Coordinate installation of joint sealers specified in Division 7 Section at penetrations of non-fire-resistive rated assemblies.
 3. Coordinate support framing and blocking requirements of all construction to be attached to gypsum board assemblies.

4. At partitions indicated to receive thermal or acoustical batts, pack insulation into cavities while framing is being fabricated for stud packs, box headers, and other framing cavities that will be inaccessible upon erection of framing.
 5. Coordinate installation with joints in adjacent construction designed to reduce transmission of sound. Do not install gypsum board assemblies in a manner to create an acoustical bridge across such joints and conditions. Conditions include but are not limited to the following:
 - a. Floor and slab acoustical isolation and similar construction details.
 - b. Acoustical isolation of structural members and components.
 - c. Mechanical ductwork acoustical joints and construction.
 6. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - a. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - METAL FRAMING

- A. General Installation Standard: ASTM C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
 2. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 4. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
- B. Fire rated wall partitions installed to provide specified design criteria requirements. Partitions continuous from floor level to underside of structure and completely fire taped.
- C. Stud and Framing Installation:
1. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
 2. Steel studs cut to proper length, plumbed and aligned, continuous runner tracks attached to structure at intervals not to exceed stud spacing specified. Anchor all exterior studs and studs adjacent to window and door frames, partition intersections and corners to runner flanges.

3. Studs for partitions indicated to be fire rated or to include sound batts shall extend to deck, unless noted otherwise.
4. Where partitions abut ceiling or deck construction or vertical structural elements, provide slip or cushion type joint between partition and structure as recommended by stud manufacturer.
5. Install double studs at all jambs, and at head conditions not requiring box beams, at all windows & doors.
6. Install supplementary framing as necessary to support fixtures, equipment services, grab bars, toilet accessories, furnishings, or similar construction. Install, or coordinate installation of wood blocking by other trade as applicable, for all such construction.
7. Install bracing at terminations in assemblies.
8. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

D. Z-Shaped Furring Members:

1. Erect furring vertically to hold insulation specified in Division 07, Section "Thermal Insulation" in place. Z-shaped furring members spaced to match stud spacing o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
4. At window and door openings, provide C or J shaped perimeter furring or tracks where detailed in Drawings and where required for fastening window framing.
5. At jambs and heads of openings in fire rated cavity walls, install 16-gauge C or J shaped perimeter framing or tracks of solid profile without cut-outs, where detailed in Drawings and where required for flame spread prevention into cavity. Framing sized to fill space from face of sheathing to back side of loose lintel, masonry veneer, or other non-combustible finish material.

E. Curved Framing: Bend track to uniform curve and locate lengths so they are tangent to arcs. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

1. Flexible Track: Use flexible track at curved walls with radius less than 8'-0". At other conditions, curved walls may either use flexible track or standard track notched at appropriate intervals and bent, or segmented at appropriate intervals, as required to produce a smooth curve in the finished work.

- F. Fastenings for Wall Supported Items: Provide and install 12-gauge wall reinforcing plates 6" high (minimum) x 1 stud space wide or 2 x 8 (minimum) x 1 stud space fire retardant wood blocking, unless specified otherwise at all stud wall areas receiving grab bars, toilet partitions, wall bumpers and other wall mounted accessories. Plates welded or screwed to studs.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Main runners attached to structure with hanger spacing as required to meet requirements of ASTM C 754, and other criteria as specified.
 - 2. Deflection limited to 1/360 of span.
 - 3. Maximum allowable spacing of main runners, 48" O.C.; and cross furring 24" maximum O.C. At openings which interrupt main runners or furring channels, reinforce grille with 3/4" channels wire tied to and parallel to main runner channels.
 - 4. Maximum allowable spacing of hangers 48" O.C.
 - 5. Install uplift bracing to structure at exterior locations, air lock vestibules, and at other spaces subject to wind uplift or sudden changes in air pressure.
 - 6. Install bracing to structure at 8'-0" on center each way in locations subject to lift due to impacts.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - 2. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards unless more stringent requirements are specified.
 - 4. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and

- appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 6. Do not attach hangers to steel roof deck.
 7. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 8. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 9. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.4 INSTALLATION - PANEL ERECTION

- A. General: Comply with ASTM C840.
- B. Panel Installation:
1. Use wallboard and sheathing of maximum lengths to minimize joints.
 2. Stagger end joints where they occur.
 3. Stagger vertical joints on opposite sides of partitions, and stagger joints between each layer of panel in multiple layer installations, by at least one framing member.
 - a. Exception: Do not bridge panels over expansion joints.
 4. Locate end joints as far as possible from center of wall or ceiling.
 5. Do not place butt ends against tapered or grooved edges. Do not place tapered edges against cut edges or ends.
 6. Support ends and edges of wallboard on framing or furring members.
 7. No wallboard installed over piping, ducts, electric boxes or conduits until they have been installed, run and tested.
 8. Attach wallboard and sheathing with screws spaced 12" O.C. and staggered along abutting vertical edges.
 9. Exterior grooved sheathing installed horizontally with tongue up.
 10. Partitions indicated sealed to deck shall be continuous except where interrupted by structure, mechanical or electrical construction.
 11. Fit gypsum panels around ducts, pipes, conduits, and structural members. Cut panels to fit profile of penetrations and apply a bead of sealant 1/4" to 3/8" wide.

12. Tape and float only is acceptable behind lockers that have solid backs unless otherwise required for partition fire or acoustical ratings.
13. Rated partitions shall have wall board continuous both sides above ceiling to deck and fire taped and sealed.
14. Partitions shown to include sound batt but not to extend to deck shall have wall board continuous to deck above ceiling and taped on one side only.
 - a. Exception: Partitions shown to have acoustical insulation placed over ceiling to either side of the partition wall.
15. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, including floors and deck. Provide 1/4- to 1/2-inch wide spaces at these locations. Trim edges with edge trim where edges of panels will be exposed in the completed work. Seal joints between edges and abutting structural surfaces with acoustical sealant.
16. Form control and expansion joints with space between edges of adjoining panels.
17. Refer to Division 07, Section "Expansion Control" for installation of expansion control joints and expansion joint covers located within or adjacent to gypsum board assemblies.

C. Curved Surfaces:

1. Install panels perpendicular to supports and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For multiple-layer construction, fasten base layer(s) to studs with screws 16 inches O.C. Stagger joints between successive layers. Fasten finish layer to studs with screws spaced 12 inches O.C.

D. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

E. Wall Tile Substrate: ANSI A108.11

1. Install tile backer board as substrate for thin set ceramic tile.
2. Space 1/4" above fixture lips.
3. Seal ends, cut edges and penetrations of each piece with water resistant compound before installation.
4. Tape & mortar over all joints prior to tile installation.

F. Accessory Installation:

1. Corner Beads: Install on external corners with suitable fasteners spaced 9" O.C.

2. Metal Trim: Install over face layer with fasteners spaced 9" O.C. where shown and where gypsum surfaces meet dissimilar materials.
3. Control Joint: Install control joints in locations where detailed, and the following, unless otherwise indicated:
 - a. At changes in backup material.
 - b. Vertically in partition walls at 30'-0" maximum on center.
 - c. Horizontally in partition walls taller than 16'. Confirm elevations of such joints with Architect.
 - d. In large ceilings 20'-0" maximum on center each way.
 - 1) Also at perimeter of ceilings indicate reflected ceiling plans.
 - e. At interior side of all exterior door and window frames.
 - f. At both sides of all interior and exterior door and window frames.
4. Aluminum Trim: Install in locations indicated in Drawings.

G. Joint Treatment Application:

1. Joint treatment compounds and products, as specified under Materials, shall be mixed and applied in accordance with manufacturer's direction to completely conceal all joints and screw depressions and provide a smooth surface to receive finishes as scheduled.

3.5 FINISH

- A. Finish Level: Provide Level 5 for all Gypsum Board Assemblies, unless otherwise specifically indicated.
- B. Apply gypsum board finish in accordance with ASTM C 840, manufacturer's published instructions and GA-214 Finish Levels.
 1. Level 1: All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - a. Application: In plenum areas above ceilings, in attics, in mechanical rooms, and in other areas where the assembly is generally concealed and not normally open to view. Accessories not required unless otherwise indicated or required by fire rated or acoustical rated construction.
 - 1) Where a fire resistance rating is required for the gypsum board assembly, details of construction shall be in accordance with reports of fire tests of assemblies that have met the fire rating requirement.
 - 2) Where acoustical rating requires more stringent finish application, comply with acoustical partition construction requirements.

2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges and sand joints. Provide level 2 finish where panels are substrate for tile, behind plywood backer boards, in mechanical and electrical rooms and where specifically indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface, and sand smooth. Provide Level 4 finish typical, where panels are to receive painted finish unless specifically indicated otherwise.
 - a. Texture for level 4 finish: Light sand texture as approved by Architect through sample and mockup review.
4. Level 5: All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. Finished work free of noticeable defects which include joint ridging, staved joints, board edges damaged or out of place, joint blisters, nail pops, pinholes in joint treatment or any other noticeable defects. Finished work true to line, perfectly smooth and ready for painting or wall covering.
5. Prepared surfaces shall be coated with a primer/sealer prior to the application of finish paint. Refer to specification Division 9 Section for painting.
 - a. Application: For use where gloss semi-gloss, enamel, eggshell, or non-textured flat paints are specified or where severe lighting conditions occur. Generally, in all areas except where noted otherwise.

3.6 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.

- f. Installation of ceiling support framing.

3.7 PATCHING AND REPAIR

- A. Contractor shall repair and patch around penetrations in existing walls where new piping, ductwork, conduit, cables, etc. are required.
- B. Remove and replace gypsum board panels that become wet, moisture damaged, or exhibit evidence of mold.

3.8 CLEANING

- A. Contractor shall completely clean all areas affected by this work and shall leave no excess or scrap materials or bedding compound on the job site.

END OF SECTION 09 21 16

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Large format porcelain tile floor, wall and base.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
 - 2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 9 Section "Gypsum Board Assemblies" for cementitious backer units, glass-mat, water-resistant backer board.

1.3 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499 plus joint width indicated.
- B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory for each color and finish required.

E. Master Grade Certificates: For each shipment, type and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall & base tile installation.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 5. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by a pre-approved manufacturer.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile", for types, compositions and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
 - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Match Architect's samples.
- D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
 - 1. Where tile is indicated for installation on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS:

- A. Tile "CT1"(W2): Dal-Tile (or equal) Porcelain Tile (Interior wall and base) 12" x 24 Collection: Chord Porcelain – . Color (as selected by Architect from full line of manufacturers colors.
- B. Tile "CT2"(F2): Dal-Tile (or equal) Porcelain Tile (Floors) 12" x 24," Collection Color Match) unpolished Porcelain – Unity Series. Color (Urban Putty) (Color Wheel Classic) as selected by Architect from full line of manufacturers colors.
- C. Tile "CT3": Porcelain Tile (Interior backsplashes) 2"x 10", Collection: Remedy Look Porcelain Subway Tiles. Color: Antidote.

2.4 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:

1. Atlas Minerals & Chemicals, Inc.
2. Bonsal, W. R., Company.
3. Bostik.
4. C-Cure.
5. Custom Building Products.
6. DAP, Inc.
7. LATICRETE International Inc.
8. MAPEI Corporation.
9. Southern Grouts & Mortars, Inc.
10. Summitville Tiles, Inc.
11. TEC Specialty Products Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:

1. Prepackaged dry-mortar mix combined with styrene-butadiene-rubber liquid-latex additive.
 - a. For wall applications, provide non-sagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

C. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:

1. Prepackaged dry-mortar mix combined with styrene-butadiene-rubber liquid-latex additive.

D. Chemical-Resistant, Water-Cleanable, Grouting Epoxy (at All floor, base and wall applications): ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by grout manufacturer for intended use.
 - a. Laticrete “Latapoxy SP-100” stainless epoxy grout or approved equal.
 - b. Un-sanded grout mixture for joints 1/8 inch and narrower.
 - c. Sanded grout mixture for joints 1/8 inch and wider.

2.5 ELASTOMERIC SEALANTS

A. Refer to Specification Section 079200 - Joint Sealants.

2.6 MISCELLANEOUS MATERIALS

- A. Metal edge and corner trim: Schluter (or equal) to be provided at ALL corners, edges and transition to non-tile material as follows:
 - 1. Wall tile outside corners vertical – Jolly 3/8” satin nickel anodized aluminum edge trim
 - 2. Wall tile outside corners horizontal – Quadec 3/8” satin nickel anodized aluminum edge trim
 - 3. Edge transition wall tile to brick – Jolly 3/8” satin nickel anodized aluminum edge trim
 - 4. Edge transition floor tile to steel grating or other non-tile material – Schiene 1/2” satin nickel anodized aluminum edge trim
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
 - 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. After reviewing with Architect/Structural Engineer demolish concrete slab in existing showers as necessary to accommodate modeled shower tray.
- C. Install membrane waterproofing system per manufacturer's instructions.
- D. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- E. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- F. Field-Applied Temporary Protective Coating: Where needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation". Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated. NO CUT TILES PERMITTED.
- G. Install metal wall trim at all corners and edge transitions as per manufacturer's printed instructions.
- H. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants".
- I. Grout tile to comply with requirements of the following tile installation standards:
 - 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
 - 1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
 - a. Tile floors in wet areas.
 - b. Tile floors composed of tiles 8-by-8-inches or larger.
 - c. Tile floors composed of rib-backed tiles.
- B. Joint Widths: Install tile on floors with the following joint widths:
 - 1. Large format tile: 1/16 inch.

3.5 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Install metal lath and scratch coat for walls to comply with ANSI A108.1A, Section 4.1.
- C. Joint Widths: Install tile on walls with the following joint widths:
 - 1. Large format tile: 1/16 inch.

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 13

SECTION 09 51 23 – ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Provide acoustical ceilings as shown on the drawings and as herein specified.

- B. Related Sections include the following:

- 1. Division 09 Section - Gypsum Board Assemblies, for gypsum board ceilings support system.
 - 2. Division 21 through 28 Mechanical and Electrical Sections, for coordination with devices installed in grid ceilings.

1.3 QUALITY ASSURANCE

- A. Fire Hazard Classification: Maximum flame spread, Class A (less than 25) as tested in accordance with ASTM E-84 and per Fed. Spec. SS-S-118a.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.
- B. Samples: Set of 4" x 4" square samples for each acoustical unit required, showing full range of exposed color and texture to be expected in completed work.

1.5 COORDINATION

- A. Contractor shall coordinate connection of lighting and electrical devices to grid. Where lighting fixtures are provided with integral clips, install lighting fixture with the clip attachments and not with screws through grid tees.

PART 2 - PRODUCTS

2.1 CEILING TILE AND GRID

- A. Products: Subject to compliance with requirements, provide acoustical ceiling tile and grid as manufactured by Armstrong, or approved equal.
- B. Acoustical Panels:
 - 1. 24" x 24" x 3/4" fiberglass tile for lay-in grid suspension system. Panel design is Armstrong "Optima®" Tegular, with factory-applied latex finish, or approved equal. Color shall be white.
 - a. NRC: Minimum .90
 - b. Use with Grid Type 1.
- C. Lay-in Suspension System: Exposed steel members made for use with panel types specified. System supplied with all main runner tees, cross tees, wall angles, clips, connectors, fastening and hangar wires. Subject to compliance with requirements, provide the named products below, or approved equal in finishes as specified below:
 - 1. Grid Type 1: Grid to be 24" x 24" pattern with white finish. Armstrong's "Suprafine ML," 9/16" exposed tee, or approved equal.

2.2 MISCELLANEOUS MATERIALS

- A. Uplift Bracing and Retention Clips: Provide uplift bracing and retention clips designed to prevent tiles from dislodging due to wind or air pressure changes at exterior grid, grid in airlock vestibules, and in similar locations subject to wind or sudden changes in air pressure.
 - 1. Provide retention clips at all plank type tile as recommended by Manufacturer.
 - a. Equal to Armstrong Universal Hold-Down clip for typical air pressure uplift locations unless otherwise recommended.
- B. Eggcrate Lens & Grid: Plastic eggcrate with 1/2" x 1/2" x 1/2" cubes molded of translucent white acrylic. The louvers shall have a uniform appearance in the continuous row and shall include edge angle and cross grids, color white.

1. Locations: Where shown on the Drawings.
- C. Edge Treatment for cut edges of tegular and grooved edge ceiling tiles and planks: Manufacturer's recommended touch up paint.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ceiling grids and acoustical panels completely installed in all areas indicated. Ceiling plenum shall be completely enclosed from adjoining conditioned space by structure, partitions, and/or acoustical panels.
- B. Suspension systems installed by direct suspension from structural systems in accordance with manufacturer's specification. Hanger wire shall support no greater than 16 square feet. Install additional hangers at ends of each suspension member, at each end of light fixtures, and 6 inches from vertical surfaces. Do not splay wires more than 5 inches in a 4 foot drop. Bottom of surfaces shall be flush and level. Miter corners where wall moldings intersect.
- C. Install grid with uplift bracing and retention clips where required.
- D. The plumbing and heating contractors shall not utilize hangers or framing of suspension system. The electrical contractor may utilize suspension system for lay-in fixture installation but shall furnish two supplementary hangers per fixture for maintaining maximum load deflection. Electrical contractor shall not utilize tile as sole support for any ceiling-mounted electrical device. All ceiling-mounted electrical devices shall be supported with brackets attached to tees.
- E. Ceilings laid out as shown on the drawings, however, if not specifically shown, ceilings laid out from center of room in both directions so that cut tiles are equal at all edges. Place materials to have full bearing on suspension members.

3.2 INSPECTION

- A. Following installation, soiled or discolored units cleaned to match adjacent perfect material. Any broken or damaged material which cannot be corrected by cleaning, removed and replaced with perfect material.

END OF SECTION 09 51 23

SECTION 09 65 13 - RESILIENT BASE 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. Vinyl base.
 - 2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to

demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Armstrong World Industries, Inc.
 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 3. Flexco.

4. Johnsonite; a Tarkett company.
 5. Roppe Corporation, USA.
- B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).
1. Group: I, solid, homogeneous.
 2. Style and Location:
 - a. Style A, Straight: In all locations.
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (101.6 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors and Patterns: As selected from manufacturers' full range of colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - 3. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 67 23 - FLOORING – URETHANE RESINOUS CEMENT COVE BASE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installation of urethane cement cove base at the perimeter of walk-in cooler spaces.
- B. Cove base shall be installed at the junction of concrete floor and wall surfaces to provide a sanitary, cleanable transition.
- C. Flooring surface beyond the cove base is not included in this section.

1.02 REFERENCES

- A. ASTM F1869 – Moisture Vapor Emission Rate of Concrete.
- B. ASTM F2170 – Relative Humidity in Concrete Floor Slabs.
- C. USDA / FDA Guidelines for Sanitary Flooring.
- D. Manufacturer’s published installation instructions.

1.03 SUBMITTALS

- A. Product Data
- B. Installation Instructions
- C. Samples
- D. Warranty

1.04 QUALITY ASSURANCE

- A. Installer experienced in urethane cement systems.
- B. Installation per manufacturer requirements.
- C. Pre-installation meeting required.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in original containers.
- B. Store per manufacturer requirements.
- C. Protect from freezing.

1.06 ENVIRONMENTAL CONDITIONS

- A. Install only under manufacturer-approved conditions.
- B. Coordinate with cooler commissioning.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Sika Corporation
- B. Product: Sika® PurCem® VG

2.02 MATERIALS

- A. Urethane cement cove base: Sika® PurCem® VG.
- B. Primer and sealer as required by manufacturer.

2.03 COVE BASE CONFIGURATION

- A. Height: 6 inches.
- B. Radius: $\frac{3}{4}$ –1½ inches.
- C. Thickness: $\frac{1}{4}$ inch minimum.
- D. Finish: Smooth, troweled.
- E. Color: As selected.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify substrates are sound and clean.
- B. Correct deficiencies prior to installation.

3.02 SURFACE PREPARATION

- A. Mechanically prepare concrete.
- B. Repair defects.
- C. Prepare wall surfaces.

3.03 INSTALLATION

- A. Install per manufacturer instructions.
- B. Apply primer as required.
- C. Trowel-apply cove base continuously.
- D. Ensure smooth radius and seamless integration.

3.04 CURING AND PROTECTION

- A. Cure per manufacturer requirements.
- B. Protect from damage.

3.05 CLEANING

- A. Clean adjacent surfaces.

3.06 WARRANTY

- A. Provide manufacturer's standard warranty.

END OF SECTION 09 91 00

SECTION 09 81 00 – SOUND ATTENUATION BATT INSULATION

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. Provide sound insulation as shown on the Drawings and as herein specified.
- B. Related Documents: The Contract Documents, as defined in Division 01 Section – Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.
- C. Related Sections include the following:
 - 1. Division 07 Section “Thermal Insulation”
 - 2. Division 09 Section "Acoustical Ceiling”

1.3 QUALITY ASSURANCE

- A. Design Criteria:
 - 1. Sound Transmission Class: 5- to 10-decibels.
 - 2. Fire Resistance: Material shall have a Class B fire-rating less than 75 as tested by ASTM E84.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original packaging, clearly marked with brand name, type, and R-Value.
- B. Store materials in an area protected from weather, moisture, and damage, remove any damaged materials from the site.

1.5 SUBMITTALS

- A. Samples of materials and complete product and technical description submitted for approval to the Architect prior to ordering materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. SOUND ATTENUATION BATT INSULATION in metal stud walls: Unless otherwise noted, provide nominal 3½-inch-thick unfaced batt insulation complying with ASTM C665, Type 1, produced by combining resins with mineral fibers manufactured from glass, slag wool, or rock wool. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Basis-of-Design: EcoTouch® Sonobatts®, as manufactured by Owens-Corning.
 - 2. Industrial Insulation Group, LLC.
 - 3. Roxul AFB® as manufactured by Roxul, Inc.
- B. SOUND ATTENUATION BATT INSULATION where indicated on Drawings above lay-in ceiling: 3½-inch, unfaced batt insulation with an R-Value of 11. Provide EcoTouch® Sonobatts® fiberglass batts as manufactured by Owens-Corning.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas receiving insulation work to ensure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from mortar droppings, grease, oil, or other debris which would affect proper insulation. Application constitutes acceptance of substrate conditions.

3.2 INSTALLATION

- A. Insulation installed in accordance with current printed recommendations of insulation manufacturer.
- B. Insulation installed in wall cavities exceeding 8-feet in height, the mat shall be overlapped at least one inch.

END OF SECTION 09 81 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do Not Paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts and labels.
 - 1. Pre-finished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Metal lockers.
 - c. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.

- f. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized or factory painted aluminum.
 - b. Stainless steel.
 - c. Copper and copper alloys.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related Sections include, but are not limited to, the following:
- 1. Division 05, Section "Metal Fabrications" for shop priming ferrous metal to receive paint.
 - 2. Division 06, Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
 - 3. Division 08, Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
 - 4. Division 09, Section "Gypsum Board Assemblies" for surface preparation of gypsum board to receive paint.

1.3 REFERENCES

- A. Publications and standards listed herein are part of the specification to the extent referenced. The criteria established in the specifications shall take precedence over the standards referenced herein.
- 1. SSPC - Society for Protective Coatings; "Surface Preparation Standards."
 - 2. NACE International - The National Association of Corrosion Engineers International; "NACE Standards."
 - 3. PDCA - Painting and Decorating Contractors of American; "PDCA Industry Standards."

1.4 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- 1. Flat, refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.

2. Eggshell, refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi-gloss, refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss, refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.5 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Initial Selection: For each type of finish-coat material indicated.
 1. After color selection, Architect will furnish color chips for surfaces to be coated.
- C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 3. Submit three (3) Samples on the following substrates for Architect's review of color and texture only:
 - a. Concrete: 4-by-6-inch Samples for each color and finish.
 - b. Painted Wood: 12-inch-square Samples for each color and material on hardboard.
 - c. Stained or Natural Wood: 6-by-10-inch Samples of natural- or stained-wood finish on representative wood surfaces.
 - d. Ferrous Metal: Square Samples of flat metal and 8-inch-long Samples of solid metal for each color and finish.
- D. Qualification Data: For Applicator.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 - 1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - 3. Final approval of colors will be from benchmark samples.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.8 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.9 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 - 1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Painting Schedule at the end of this Section indicates paint products from PPG Industries. Equal products from the following additional manufacturers are approved for use on this Project:
 - 1. Benjamin Moore & Co. (Benjamin Moore).
 - 2. Glidden Professional (Glidden Professional/PPG).
 - 3. PPG Industries, Inc. (Pittsburgh Paints).
 - 4. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: As selected by Architect from manufacturer's full range. Color selection samples to include, at a minimum, the following areas:
 - 1. Exterior exposed concrete columns.
 - 2. Exterior Portland cement plaster.
 - 3. Primary interior gypsum board.
 - 4. Secondary gypsum board, @ band (10' - 0" to 13' - 3")
 - 5. Accent gypsum board walls (inside face of all gypsum board at exterior walls)
 - 6. Interior exposed steel columns, beams, misc. steel.
 - 7. Interior exposed concrete columns.
 - 8. Interior exposed CMU.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 3. Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 4. Ferrous Metals: Clean un-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Clean steel surfaces as recommended by paint system manufacturer.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

- c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- 5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.2 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
 - 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Exposed un-insulated metal piping.
 2. Exposed un-insulated plastic piping.
 3. Exposed pipe hangers and supports.

4. Exposed visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 5. Exposed duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 7. HVAC diffusers and grilles installed on or within painted wall or soffit surfaces.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Electrical equipment that is located in areas exposed to the general public.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- L. Field Repairs of Hot-Dip Galvanized Metal Finishes: Where approved by Architect, minor damages or imperfections may be refinished as follows:
1. Preparation: Remove oil or soap film with detergent or emulsion cleaner. Power clean surface to SSPC SP 11.
 2. Surfaces to Receive Paint Finish: Apply one coat of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (applied immediately after preparation completed.)
 3. Surface with Exposed Galvanized Finish: Apply two coats of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (Apply first coat immediately after preparation completed.)

3.3 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove non-complying paint from Project site, pay for testing, and repaint surfaces previously coated with the non-complying paint. If necessary, Contractor may be required to remove non-complying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing, or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Low-Luster Acrylic Finish:
 - a. Primer: PPG; 90-912 Series Pitt-Tech Plus Int/Ext DTM Industrial Primer; 2.0 to 4.0 Dry Mils.

- b. Intermediate: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0 Dry Mils.
 - c. Finish Coat: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0.
 - B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Low-Luster Acrylic Finish:
 - a. Primer: PPG; 90-912 Series Pitt-Tech Plus Int/Ext DTM Industrial Primer; 2.0 to 4.0 Dry Mils.
 - b. Intermediate: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0 Dry Mils.
 - c. Finish Coat: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0 Dry Mils.

3.7 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Low-Luster Acrylic Finish (Zero VOC Option):
 - a. Primer: PPG; 6-4900XI Speedhide zero Interior Zero VOC Latex Sealer (0 g/L VOC); 1.2 Dry Mils.
 - b. Intermediate: PPG; 6-4310XI Series Speedhide zero Interior Zero VOC Latex Eggshell (0 g/L VOC); 1.4 Dry Mils.
 - c. Finish Coat: PPG; 6-4310XI Series Speedhide zero Interior Zero VOC Latex Eggshell (0 g/L VOC); 1.4 Dry Mils.
- B. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:
 - 1. Clear Wood Finish - Satin Acrylic Polyurethane:
 - a. First Coat: PPG; 42786 Olympic Interior Water Based Polyurethane Satin Clear Finish (237 g/L VOC); 0.8 to 1.1 Dry Mils.
 - b. Finish Coat: PPG; 42786 Olympic Interior Water Based Polyurethane Satin Clear Finish (237 g/L VOC); 0.8 to 1.1 Dry Mils.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Satin Acrylic Enamel Finish (ZERO VOC TOPCOAT OPTION, Primer not zero VOC):

- a. Primer: PPG; 90-912 Series Pitt-Tech Plus Int/Ext DTM Industrial Primer (90 g/L VOC); 2.0 to 4.0 Dry Mils.
 - b. Intermediate: PPG; 6-4410XI Series Speedhide zero Interior Zero VOC Latex Satin (0 g/L VOC); 1.5 Dry Mils.
 - c. Finish Coat: PPG; 6-4410XI Series Speedhide zero Interior Zero VOC Latex Satin (0 g/L VOC); 1.5 Dry Mils.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Satin Acrylic Enamel Finish (Zero VOC Option - Primer not zero VOC):
 - a. Primer: PPG; 90-912 Series Pitt-Tech Plus Int/Ext DTM Industrial Primer (90 g/L VOC); 2.0 to 4.0 Dry Mils.
 - b. Intermediate: PPG; 6-4410XI Series Speedhide zero Interior Zero VOC Latex Satin (0 g/L VOC); 1.5 Dry Mils.
 - c. Finish Coat: PPG; 6-4410XI Series Speedhide zero Interior Zero VOC Latex Satin (0 g/L VOC); 1.5 Dry Mils.
- E. Exposed Ceiling Structure (Includes all existing ductwork, piping & conduit): Provide the following finish systems over existing surfaces:
 - 1. Dryfall - Flat Black:
 - a. Finish Coat: PPG; 6-723XI SpeedHide SuperTek WB Interior Latex Dryfall system. Prep existing surfaces & apply in strict conformance with paint manufacturer's written recommendations. Spray apply only.

3.8 EXTERIOR HIGH-PERFORMANCE SCHEDULE

- A. Ferrous Metal: Provide the following finish system over exterior ferrous metal.
 - 1. Semi-Gloss Urethane Finish:
 - a. Primer: PPG; Amerlock 2 VOC Epoxy Coating; 4.0 to 6.0 Dry Mils.
 - b. Intermediate: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils.
 - c. Finish Coat: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils.
- B. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semi-Gloss Urethane Finish:
 - a. Primer: PPG; Amerlock 2 VOC Epoxy Coating; 4.0 to 6.0 Dry Mils.

- b. Intermediate: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils.
- c. Finish Coat: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils.

3.9 INTERIOR HIGH-PERFORMANCE SCHEDULE

A. Ferrous Metal: Provide the following finish system over interior ferrous metal.

1. Semi-Gloss Epoxy Finish:

- a. Primer: PPG; Amerlock 2 VOC Epoxy Coating; (84 g/L VOC) 4.0 to 6.0 Dry Mils.
- b. Intermediate: PPG; Amerlock 2 VOC Epoxy Coating; (84 g/L VOC) 4.0 to 6.0 Dry Mils.
- c. Finish Coat: PPG; Amerlock 2 VOC Epoxy Coating; (84 g/L VOC) 4.0 to 6.0 Dry Mils.

END OF SECTION 09 91 00

SECTION 09 97 23 – CONCRETE SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concrete floor sealer & floor wax for concrete floors indicated to receive a sealed finish.
- B. Related Sections Include the following:
 - 1. Division 03, Section "03 30 00 - Cast-in-Place Concrete."

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including surface preparation and application instructions.
- B. Installer's Project References: Submit list of successfully completed projects, including project name and location, name of architect, and type and quantity of concrete floor finishing
- C. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Concrete floor finish materials shall be products of a single manufacturer.
- B. Installer's Qualifications:
 - 1. Successful experience in application of similar concrete floor finishes.
 - 2. Employ persons trained for application of concrete floor finishes.
- C. Preinstallation Meeting: Convene a preinstallation meeting before start of application of concrete floor finishes. Require attendance of parties directly affecting work of this

section, including Contractor, Architect, and application. Review surface preparation, application, protection, and coordination with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying manufacturer, product name, and concrete floor stain color.
- B. Storage: Store materials in a clean, dry area indoors in accordance with manufacturer's instructions. Keep containers sealed until ready for use.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply concrete floor finishes when air or surface temperature is below 40 deg F.
- B. Concrete Floor Sealer: Do not apply when air or surface temperature is below 55 deg F.

1.7 SEQUENCING

- A. Prepare surface and apply concrete floor finish after other interior finish work is completed and before baseboards and installed.

1.8 WARRANTY

- A. Provide Manufacturer's standard one year warranty.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR SEALER

- A. Clear, water-based, 40 percent alkylalkoxysilane penetrating sealer providing protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion.
- B. Concrete Floor Sealer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. BASF Corporation.

2. Concrete Coatings Inc.
 3. L & M Construction Chemicals, Inc.
 4. The Euclid Chemical Company.
 5. Or approved equal
- C. Basis-of-Design Product: Provide clear, water-based, 40 percent alkylalkoxysilane penetrating sealer at all concrete floor surfaces indicated to receive a sealed finish; MasterProtect H 400 (formerly Enviroseal 40) by BASF; or approved equal.
- D. Water-repellent sealer shall have the following minimum performance:
1. Compliance: Alberta DOT, Type 1b.
 2. Flash Point, ASTM D3278, SETA: Greater than 200 degrees F (93 degrees C).
 3. Water Absorption, ASTM C 642.
 - a. 48 Hours: 0.42 percent.
 - b. 50 Days: 1.2 percent.
 4. Scaling Resistance Rating, ASTM C672, non-air-entrained concrete, 100 cycles treated concrete: 0; no scaling.
 5. Resistance to Chloride-Ion Penetration, AASHTO T259 and T260.
 - a. Criteria of 1.5 at 1/2 inch (13 mm): Less than 0.52 lbs per cy (0.31 kg/m³).
 - b. Criteria of 0.75 at 1 inch (25 mm): 0.00 lbs per cy (0.00 kg/m³).
 6. Water Weight Gain, NCHRP 244 Series II Cube Test: 85 percent reduction, exceeds criteria.
 7. Absorbed Chloride, NCHRP 244 Series II Cube Test: 87 percent reduction, exceeds criteria.
 8. Absorbed Chloride, NCHRP 244 Series IV Southern Climate: 99 percent reduction, exceeds criteria.
 9. Water Repellent Performance, Alberta Transportation and Utilities Procedures Type 1b:
 - a. Initial Performance: 89 percent.
 - b. Post-Abrasion Performance: 89.4 percent
 10. Solids and Active Ingredients: 40 percent by weight.
 11. Specific Gravity, 77 degrees F (25 degrees C): 0.95.
 12. Density: 7.9 lbs per gal.
 13. Penetration, average depth, depending upon substrate: 0.24 inch (6.1 mm).
 14. VOC Content, EPA Method 24: Less than 2.92 lbs per gal (350 g/L), less water and exempt solvents.
- E. Concrete Floor Wax: Provide 2 coats of manufacturer's recommend slip-resistant, wax over all floors specified to receiving sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive concrete floor finishes. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Protection:
 - 1. Protect walls and surrounding surfaces not to receive concrete floor finishes.
 - 2. Do not allow stain to come in contact with wood or metal surfaces.
- B. Prepare concrete surface in accordance with manufacture's instructions.
- C. Concrete shall be as specified in Secion 03 30 00. Ensure concrete is a minimum of 28 days old.
- D. Ensure concrete surface is clean, dry, structurally sound, and free from dirt, dust, oil, grease, solvents, paint, wax, asphalt, concrete curing compounds, sealing compounds, surface hardeners, bond breakers, adhesive residue, and other surface contaminants.
- E. Do not acid wash or use heavy alkali cleaners.

3.3 APPLICATION

- A. Apply concrete floor finishes in accordance with manufacture's instructions at locations indicated on the drawings.
- B. Concrete Floor Sealer: Apply concrete floor sealer over concrete floor stain in accordance with manufacturer's instructions.
- C. Keep material containers closed when not in use to avoid contamination.
- D. Concrete Floor Wax: Apply to sealed concrete floor surfaces as per manufacturer written recommendation.

3.4 PROTECTION

- A. Protect sealed concrete floor from damage during construction.
- B. Protect concrete surfaces from foot traffic for a minimum of 24 hours.

- C. Void washing concrete surfacews for a minimum of 48 hours.

END OF SECTION 09 97 23

SECTION 10 14 23.13 - ROOM IDENTIFICATION SIGNAGE

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. Room-identification, panel signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size scale.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(s), in manufacturer's standard size unless otherwise indicated and as follows:
 1. Panel Signs: Full-size Sample.
 2. Exposed Accessories: Full-size Sample of each accessory type.
- E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design, and the 2012 Texas Accessibility Standards (TAS).

2.2 PANEL SIGNS

- A. Panel Sign: ADA and ADA compliant signs with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ARK Ramos.
 - b. ASI Modulex, Inc.
 - c. Best Sign System, Inc.
 - d. Corpus Christi Stamp Works, Inc.
 - e. Gemini Incorporated.
 - f. Metal Arts.
 - g. Southwell Company.
 - h. System 290,
 - i. Vomar Products.
 - j. Or other approved manufacturer.
 - 2. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
 - a. Composite-Sheet Thickness: 6.35 mm (0.25 inch).
 - b. Engraved Graphics: Characters machine engraved through plastic-laminate face sheet to expose contrasting phenolic core.
 - c. Plastic-Laminate Color and Pattern: Matte, "White."
 - d. Core Color: Manufacturer's standard "Gray."
 - 3. Braille: Raised Tactile Grade 2 Braille shall be integral with the sign face and be raised 0.031 mm (1/32"). Glass or metallic rasters to have .059 mm surface diameter with body of sphere pressure secured below face laminate. Glued on dots will NOT be acceptable.
 - 4. Raised symbols shall be 76 mm (3" high), raised 0.031 mm (1/32") from sign face and unitized with the acrylic sign core.
 - 5. Sign-Panel Perimeter: Finish edges, polished smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Rounded to 3 mm (1/8") radius.

6. Mounting: Two-face tape.
7. Text and Typeface: As indicated on the Drawings. Finish engraved characters to contrast with background color, and finish Braille to match background color.
8. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1.5 mm (1/16 inch) measured diagonally from corner to corner.
9. Backer Panel: For signs mounted on glass sidelites, provide a blank, plastic-laminate sheet the same size, shape, and color as the as the room-identifications; and mount the backer panel to the glass sidelite, directly behind the room-identification sign with double sided tape.

2.3 PANEL-SIGN MATERIALS

- A. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 1.2 mm (0.048-inch) nominal thickness.

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 1.14 mm (0.045 inch) thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.
- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.

3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by the Contracting Officer.

END OF SECTION 10 14 23.13

SECTION 10 28 00 – TOILET, BATH, AND LAUNDRY 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:
 - B. Toilet and bath accessories for public-use toilets, private-use toilets.
- C. Related Requirements:
 - 1. Section 06 10 53 “Miscellaneous Rough Carpentry” for wood block.
 - 2. Section 09 21 16 “Gypsum Board Assemblies” for partition systems.
 - 3. Section 09 30 13 “Ceramic Tiling” for attachment substrate.
 - 4. Division 22 “Plumbing” for plumbing fixtures and related coordination.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 SUBMITTALS

- A. Submittals: Manufacturer's Product Data. Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule at the back of this section.

1. Products of other listed manufacturers with equal characteristics, as judged solely by Architect, may be provided.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, visible silver spoilage defects.
 2. Warranty Period: 10 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Basis of Design – American Specialties, Inc., Seachrome, Inc., and Bobrick Washroom Equipment, Inc. Subject to compliance with requirements, provide accessories by one of the following:
 1. Toilet and Bath Accessories:
 - a. American Specialties, Inc., (AS)
 - b. Bobrick Washroom Equipment, Inc., (BOB)
 - c. Bradley Corporation.
 - d. McKinney/Parker Washroom Accessories Corp.
 - e. Whitehall Manufacturing.
 - f. Or Approved Equal

2.2 MATERIALS

- A. Materials as follows:
 1. Stainless Steel: ASTM A 666, Type 304 or 316, with No. 4 finish (satin), in minimum nominal thickness, unless otherwise indicated.
 2. Brass: ASTM B 19, leaded and unleaded flat products; rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
 3. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

4. Galvanized Steel Sheet: ASTM A 653/A 653M.
5. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
6. Baked-Enamel Finish: Factory-applied, gloss, baked-acrylic-enamel coating from manufacturer's standard colors.
7. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
8. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
9. Fasteners: Screws, bolts, and other devices of stainless steel as accessory unit, tamper and theft resistant when exposed, and of stainless steel when concealed.
10. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.3 FABRICATION

- A. General Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's Representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendation.

3.3 TOILET ACCESSORY SCHEDULE

RESTROOM : (103,104 & 111)

QTY	ITEM	MODEL NO
3	Mirror	B-165 18" x 36"
3	Soap Dispenser	B-4112
3	Toilet Tissue Dispenser	Global Industrial #237500
3	Grab Bar	B-6806-36"
3	Grab Bar	B-6806-42"
6	Coat Hooks	B-212
3	Waste Receptacles	Global Industrial #WBB56136
3	Paper Towel Dispenser	AS, Roval, 20210, surface mounted
1	Baby Changing Station (Room 104 Only)	Koala Kare KB300-01

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QTY	ITEM	MODEL NO
1	Mop/Broom Holder	Bradley 9984
1	Utility Hook Strip	American Specialties 1307
1	Storage Shelving	American Specialties 0692

END OF SECTION 10 28 00

SECTION 11 41 00 – COMMERCIAL WALK-IN COOLER SYSTEMS (BASIS OF DESIGN SPECIFICATION)

PART 1 – GENERAAL

1.1 SUMMARY

- A. Section includes commercial walk-in cooler system including insulated panels, concrete floor over insulation, oversized door, remote air-cooled condensing unit suitable for coastal environments, evaporator, refrigeration piping, controls, and electrical power.

1.2 REFERENCES

- A. International Building Code (IBC).
- B. International Mechanical Code (IMC).
- C. International Energy Conservation Code (IECC).
- D. NFPA 70 – National Electrical Code (NEC).
- E. ASHRAE 15 – Safety Standard for Refrigeration Systems.
- F. ASHRAE 34 – Refrigerant Designation.
- G. NSF/ANSI 7 – Commercial Refrigeration.
- H. UL 471 – Commercial Refrigeration Equipment.
- I. EPA SNAP Regulations.

1.3 SUBMITTALS

- A. Product Data: Panels, doors, condensing unit, evaporator, piping insulation, and controls.
- B. Shop Drawings: Plans, elevations, door clearances, condensing unit location, and refrigerant piping.
- C. Electrical Submittals: Voltage, phase, MCA, MOCP, disconnects, and wiring diagrams.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years experience.
- B. Installer: Licensed refrigeration contractor experienced with remote systems.

C. Equipment shall be UL or ETL listed.

1.5 WARRANTY

A. Panels and doors: 10-year manufacturer warranty.

B. Refrigeration system: 1-year parts and labor; 5-year compressor.

PART 2 – PRODUCTS

2.1 WALK-IN COOLER ENCLOSURE

A. Panels: Foamed-in-place polyurethane, UL Listed Class 1; 5-inch thick walls and ceiling; minimum R-30; 26-ga Acrylume embossed interior; exterior Acrylume embossed with Type 304 stainless steel at door wall.

B. Floor System: Factory-fabricated recessed insulated cart floor, 4-1/8 inch UL Listed Class 1 foam; .050 aluminum interior; 26-ga Acrylume exterior; designed for 1,000 lb cart load.

2.2 CONCRETE FLOOR SLAB OVER INSULATION

A. Concrete: 4 inches minimum thickness, 4,000 psi.

B. Reinforcement: #3 12" O.C.

C. Coordinate vapor barrier and thermal break.

2.3 DOORS

A. Size: 4'-8" wide by 10'-0" high. See drawing to size verification.

B. Construction: Insulated swinging door with stainless steel hinges, self-closing hardware, magnetic gaskets.

C. Accessories: Heated frame, interior safety release, kick plates.

2.4 REFRIGERATION SYSTEM

A. Type: Split system with remote air-cooled condensing unit.

B. Refrigerant: R-454A (A2L) or approved equivalent compliant with EPA SNAP and AIM Act requirements.

C. Condensing Unit: Remote air-cooled unit; Heatcraft model LCH0010MBACYA0000 Basis of Design; microchannel condenser, corrosion-resistant cabinet, head pressure control suitable for coastal environments; 240V/1-phase/60Hz.

- D. Evaporator: Ceiling-mounted low-profile unit cooler; Heatcraft model LEL0095AY6AMAG0212 Basis of Design; air defrost; EC fan motors; 120V/1-phase/60Hz.

2.5 REFRIGERATION PIPING

- A. Type L copper, nitrogen brazed.
- B. Suction line insulation: Closed-cell elastomeric.

2.6 CONTROLS

- A. Digital temperature controller.
- B. Automatic defrost and alarms.
- C. Door switch for fan shutoff.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install per manufacturer instructions and approved submittals.
- B. Seal all joints airtight and vapor-tight.

3.2 START-UP AND COMMISSIONING

- A. Evacuate, charge, and test system.
- B. Verify controls and safeties.

3.3 TRAINING

- A. Provide owner training on operation and maintenance.

END OF SECTION 11 41 00

SECTION 11 52 23 - AUDIO-VISUAL EQUIPMENT SUPPORTS

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. Flat panel television display units.
2. Television mounting hardware.
3. Recessed in-wall back boxes for cable management.
4. Associated mounting accessories and structural support components.

B. Related Sections:

1. Division 06 – Rough Carpentry for blocking.
2. Division 26 – Electrical for power connections.
3. Division 27 – Communications for audio-visual cabling and data coordination.

1.3 QUALITY ASSURANCE

- A. Manufacturers shall have a minimum of five (5) years' experience producing commercial-grade mounting systems.
- B. Equipment shall be listed and labeled in accordance with applicable UL requirements.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's published data for televisions, mounting brackets, and recessed back boxes.
- B. Shop Drawings: Indicate mounting heights, structural support requirements, blocking, and coordination with electrical and data outlets.
- C. Coordination Drawings: Indicate power and data rough-in locations within recessed back box.

PART 2 - PRODUCTS

2.1 TELEVISIONS

- A. Basis-of-Design Product: Samsung 75-inch Commercial Flat Panel Display.

- B. Acceptable Manufacturers: Samsung or approved equal meeting the following performance requirements:
 - 1. Screen Size: 75 inches, measured diagonally.
 - 2. Resolution: 4K UHD minimum.
 - 3. Display Type: Commercial-grade LED or QLED.
 - 4. Mounting Compatibility: VESA compliant.
 - 5. Inputs: HDMI and digital inputs compatible with Owner's AV system.
 - 6. Power: 120V, 60 Hz.
 - 7. Warranty: Manufacturer's standard commercial warranty.
- 2.2 TELEVISION WALL MOUNT
- A. Basis-of-Design Manufacturer: Chief Manufacturing (Legrand AV).
 - B. Acceptable Manufacturers: Chief Manufacturing, Peerless-AV, or approved equal meeting the following:
 - 1. Fixed or tilting wall mount suitable for 75-inch display.
 - 2. Rated to support weight of specified television.
 - 3. Steel construction with durable black finish.
 - 4. VESA compatible.
- 2.3 RECESSED BACK BOX
- A. Basis-of-Design Product: Chief Manufacturing Model PAXC526F In-Wall Storage Box.
 - B. Acceptable Manufacturers: Chief Manufacturing or approved equal meeting the following performance criteria:
 - 1. Recessed in-wall enclosure designed for installation between framing members.
 - 2. Steel construction.
 - 3. Sized to accommodate AV components, receptacles, and low-voltage connections.
 - 4. Compatible with specified wall mount system.
 - 5. Depth coordinated with wall assembly.
 - 6. Compliant with applicable NEC separation requirements for power and low-voltage cabling.
- 2.4 STRUCTURAL SUPPORT
- A. Provide wood or steel blocking as required to support television, mount, and recessed back box.
 - B. Coordinate mounting locations with structural framing.

PART 3 - EXECUTION

AUDIO-VISUAL EQUIPMENT SUPPORTS

Phase 2 (100% CD Review Set)

3.1 EXAMINATION

- A. Verify wall construction and structural support prior to installation.
- B. Verify electrical and data rough-in locations.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Mount television plumb and level at locations indicated on Drawings.
- C. Coordinate final mounting height with Architect prior to installation.
- D. Install recessed back box flush with finished wall surface.
- E. Conceal cabling within wall cavity and back box.

END OF SECTION 11 52 23

SECTION 11 66 23 -WINCHES**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. Manually operated hand winches.
2. Electric cable hoists mounted on beam trolley assemblies.
3. Beam trolley assemblies.
4. Retractable cord reels.
5. Weather protection covers.
6. Accessories and mounting hardware.

B. Related Sections:

1. Division 05 Section "Metal Fabrications."
2. Division 26 Section "Electrical."

1.3 QUALITY ASSURANCE

- A. Comply with ANSI/ASME B30.7 – Winches.
- B. Comply with ANSI/ASME B30.16 – Overhead Hoists (Underhung).
- C. Electrical components shall comply with NFPA 70 – National Electrical Code.

1.4 SUBMITTALS

- A. Product Data for each winch, hoist, trolley assembly, cord reel, and weather hood.
- B. Shop Drawings indicating mounting configuration, beam flange compatibility, and load path.
- C. Operation and Maintenance Manuals including inspection intervals, lubrication requirements, and replacement part information.
- D. Warranty documentation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A.A Deliver equipment in manufacturer's original packaging.
- B. Store under cover and protect from corrosion and physical damage.

1.6 COORDINATION

- A. Coordinate beam size, flange width, and structural capacity with supporting steel.
- B. Supporting structure shall be designed for rated load plus minimum 25 percent impact factor in accordance with ASME B30.

PART 2 – PRODUCTS**2.1 MANUFACTURERS****A. Basis of Design Products:**

- 1. Hand Winch: ENDURANCE Hand Winch RBW 1000. (5 total)
- 2. Electric Hoist: BANNON Electric Cable Hoist, 1,000-LB. (2 total)
- 3. Weather Hood: ALCO Custom Covers – Winch Weather Hood. (2 total)

B. Substitutions: Provide approved equal meeting or exceeding specified performance and durability requirements.

2.2 GENERAL REQUIREMENTS**WINCHES**

- A. Provide complete hoisting systems rated for minimum 1,000-pound capacity.
- B. All equipment shall be suitable for exterior coastal marine exposure.
- C. Corrosion Protection:
 - 1. Ferrous components shall be hot-dip galvanized after fabrication.
 - 2. Zinc-plated components are not acceptable.
 - 3. Cables shall be galvanized or stainless steel.
 - 4. Fasteners shall be stainless steel or hot-dip galvanized.

2.3 HAND WINCH

- A. Basis of Design: ENDURANCE Hand Winch RBW 1000.
- B. Provide minimum 1,000-pound rated load capacity, self-locking brake mechanism, steel cable, and forged hook with safety latch.
- C. Finish shall be corrosion-resistant suitable for coastal exposure.

2.4 ELECTRIC HOIST

- A. Basis of Design: BANNON Electric Cable Hoist, 1,000-pound capacity.
- B. Performance Requirements:
 - 1. Minimum 1,000-pound rated load capacity.
 - 2. Integral automatic load-holding brake.
 - 3. Thermal overload protection.
 - 4. Pendant control.
 - 5. Minimum NEMA 4 enclosure; provide NEMA 4X where exposed to salt spray.
- C. Electrical:
 - 1. 120V, single-phase, 60 Hz unless otherwise indicated.
 - 2. Grounded cord and plug unless noted otherwise.
 - 3. GFCI-protected circuit.

4. Lockable disconnect within sight (Division 26).

2.5 BEAM TROLLEY ASSEMBLY

- A. Manual push-type beam trolley compatible with electric hoist.
- B. Minimum 1,000-pound rated capacity.
- C. Adjustable flange width to match supporting beam.
- D. Sealed bearings suitable for exterior exposure.
- E. Anti-drop plates or safety lugs.
- F. Provide beam end stops.

2.6 RETRACTABLE CORD REEL

- A. Provide spring-loaded retractable cord reel for electric hoist power supply.
- B. Cord: Three-conductor, 12 AWG, Type SOOW flexible service cord, minimum 20-foot usable length.
- C. Reel: Rated minimum 20A at 125V with ratcheting lock and adjustable cable stop.
- D. Exterior-rated construction suitable for marine exposure.

2.7 WEATHER HOOD

- A. Basis of Design: ALCO Custom Covers – Winch Weather Hood.
- B. Provide waterproof, UV-resistant cover with secure attachment and ventilation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install winches, hoists, trolley assemblies, and cord reels in accordance with manufacturer's written instructions.
- B. Coordinate electrical connections with Division 26.

WINCHES

C. Install beam end stops.

3.2 FIELD QUALITY CONTROL

A. Perform operational test under load to verify proper operation and brake engagement.

B. Confirm electrical safety devices function properly.

3.3 PROTECTION AND CLEANING

A. Protect equipment from damage during construction.

B. Clean and touch up finishes prior to Substantial Completion.

END OF SECTION 11 66 23

SECTION 11 82 23 – EXTERIOR MEAT TROLLEY SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. Work under this section includes the design, supply, and installation of an exterior meat trolley system for handling carcasses and large meat portions in an outdoor environment.
- B. The system shall be durable, hygienic, weather-resistant, and suitable for continuous exposure in coastal conditions.
- C. Related Work:
 - 1. Division 03 – Concrete (foundations, plinths, and embedded anchor plates).
 - 2. Division 05 – Metal Fabrications (structural steel support).
 - 3. Division 07 – Thermal and Moisture Protection (weatherproofing connections to buildings).
 - 4. Division 09 – Finishes (protective coatings as applicable).

1.2 REFERENCES

- A. American Institute of Steel Construction (AISC)
- B. American Welding Society (AWS) D1.6 – Structural Welding Code – Steel.
- C. ASTM International:
 - 1. ASTM A36 – Carbon Structural Steel
 - ASTM A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - ASTM A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - ASTM F2329 – Zinc Coating, Hot-Dip, on Threaded Fasteners
- D. NSF/ANSI Standards for Food Equipment.

1.3 SUBMITTALS

- A. Shop Drawings: Include trolley system layout, structural supports, hanger spacing, clearances, anchor locations, and connection details.
- B. Product Data: Manufacturer's literature on trolley components, rollers, bearings, and finishes.
- C. Samples: 150 mm (6") section of rail with finish.
- D. Certificates:

1. Material certifications for hot-dip galvanized steel grades.
2. Compliance with NSF/ANSI food safety requirements.

E. Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years of experience with hot-dip galvanized steel rail/trolley installation.
- B. Welders AWS D1.1 Certified.
- C. Regulatory Compliance: System must comply with USDA and local health authority requirements for meat handling.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in factory packaging, clearly labeled.
- B. Store off the ground, under cover, and protected from salt spray and moisture.

1.6 WARRANTY

- A. Provide manufacturer's 5-year warranty covering corrosion resistance, mechanical integrity, and operation performance.

PART 2 - PRODUCTS

2.1 MATERIALS

Basis of Design – Materials: Primary structural components including rails, trolley frames, supports, hangers, brackets, and accessories shall be carbon steel, hot-dip galvanized after fabrication.

316 Stainless steel for small components where required for function, durability, or sanitation, including but not limited to bearings, pins, axles, hooks, safety latches, and other wear or food-contact components.

A. Rail System:

1. Continuous I-beam - hot dipped galvanized steel track, ASTM A36, galvanized carbon steel grade for marine/coastal environment.
2. Profile: Minimum 80 mm deep track, smooth internal surfaces, TIG-welded joints ground flush.

B. Trolleys:

1. Hot-dip galvanized steel galvanized carbon steel housing with stainless steel ball bearings.

2. Load capacity per trolley: 800 pounds minimum.

C. Supports and Hangers:

1. Hot-dip galvanized steel brackets, ASTM A36 galvanized carbon steel with bolted connections.
2. Anchors: Hot-dip galvanized steel F593 expansion anchors or Hilti equivalent, suitable for exterior concrete/masonry.

D. Fasteners:

1. Hot-dip galvanized steel, ASTM A153 or ASTM F2329, galvanized carbon steel.
2. No painted or mechanically plated fasteners permitted.

E. Protective Coating: Hot-dip galvanized finish only.

2.2 FABRICATION

- A. Fabricate to minimize joints and crevices.
- B. Provide sloped surfaces where possible to prevent water retention.
- C. Grind and polish welds smooth to match surrounding surfaces.
- D. All components suitable for washdown cleaning with high-pressure hose.

2.3 ACCESSORIES

- A. End Stops: Positive hot-dip galvanized steel stops with rubber bumpers.
- B. Switches/Turnouts: Hot-dip galvanized steel track switches for routing to multiple lines.
- C. Safety Guards: Rail end caps to prevent accidental hook derailment.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify concrete or steel supports are level, aligned, and suitable for anchorage.
- B. Confirm clearance requirements with architectural and MEP trades.

3.2 INSTALLATION

- A. Install in accordance with approved shop drawings.
- B. Maintain alignment tolerance of ± 2 mm across rail joints.

- C. Seal exterior penetrations with marine-grade silicone sealant.
- D. Ensure smooth, quiet operation of trolleys under full load.

3.3 CLEANING

- A. Remove protective films after installation.
- B. Clean surfaces with non-chloride hot-dip galvanized steel cleaner.

3.4 COMMISSIONING

- A. Load test trolley system to 125% of rated capacity.
- B. Demonstrate smooth operation, safety latch function, and correct routing.

3.5 MAINTENANCE

- A. Provide O&M manuals with cleaning and lubrication schedules.
- B. Train owner's staff in safe operation and inspection.

END OF SECTION 11 82 23

SECTION 12 24 13 – WOOD BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes horizontal wood blinds, mounting hardware, accessories, and blind schedules.

1.3 SUBMITTALS

- A. Submit product data, shop drawings, samples, maintenance data, and warranties.

1.4 QUALITY ASSURANCE

- A. Provide products from a single manufacturer and install by qualified personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hunter Douglas Parkland® Wood Blinds basis of design.
 - 1. Levolor
 - 2. Springs Window Fashions
 - 3. Bali Blinds
 - 4. Or approved equal.

2.2 HORIZONTAL WOOD BLINDS

- A. Two-inch wood slat wood blinds with baked enamel finish.
- B. Color as selected by Architect.
- C. Manual cordless lift and wand tilt operation.
- D.

2.3 MINI BLIND SCHEDULE

At all exterior windows: 10 Total

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood blinds in accordance with manufacturer's written instructions.

3.2 PROTECTION

- A. Protect installed blinds from damage during construction.

END OF SECTION 12 24 13

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

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. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
 - 4. Metal counter/lavatory supports.

- B. Related Requirements:

- 1. Section 09 21 16, "Gypsum Board Assemblies" for coordination of installation prior to gypsum board finishes.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.

- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

- 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.

- C. Samples for Initial Selection: For each type of material exposed to view.

- D. Samples for Verification: For the following products:

- 1. Countertop material, 6 inches (150 mm) square.
 - 2. Wood trim, 8 inches (200 mm) long.
 - 3. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches (200 by 250 mm) of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide Corian® Solid Surface countertops, or equivalent provide one of the following:
 - a. Avonite Surfaces.
 - b. Formica Corporation.
 - c. Samsung Chemical USA, Inc.
 - d. Wilsonart LLC.
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - 3. Thickness: 1/2" thick.

- B. Plywood Substrate: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Radius edge with apron, 2 inches (50 mm) high with 3/8-inch (9.5-mm) radius.
 - 2. Backsplash: Unless indicated otherwise, straight, slightly eased at corner.
 - 3. End Splash: Unless indicated otherwise, match backsplash.
- C. Countertops: As indicated on the Drawings.
- D. Joints: Fabricate countertops without joints.
- E. Cutouts and Holes:
 - 1. Provide factory cut and polish cabling holes where indicated on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 13 34 19 - PRE-ENGINEERED METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pre-engineered metal building systems that consist of integrated sets of mutually dependent components as shown on the drawings and specified herein. Work shall include, but not be limited to, the following items:
 - 1. Structural steel framing and sub-framing
 - 2. Gutters, downspouts, trim and accessories
 - 3. Miscellaneous fasteners and accessories as required for erection of the metal building
- B. Quality and performance level for buildings as shown on the drawings.
- C. Structural notes indicated on the drawings regarding metal building manufacturer shall be considered a part of this specification.

1.2 RELATED WORK

- A. Pertinent Sections of Division 01.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Division 9 for finish painting of shop-primed structural framing.

1.3 REFERENCES

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. AISC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 - 2. AISC - Specification for Structural Joints Using High-Strength Bolts.
 - 3. AISC 303 - Code of Standard Practice for Buildings and Bridges.
 - 4. AISC 341-**16** - Seismic Provisions for Structural Steel Buildings, including any Supplements.
 - 5. AISC 360-**16** - Specification for Structural Steel Buildings.
 - 6. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 7. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 8. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - 10. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

11. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
12. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
13. ASTM A992 - Standard Specification for Steel for Structural Steel Shapes.
14. ASTM A1011 - 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.
15. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
16. ASTM F436 - Standard Specification for Hardened Steel Washers.
17. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
18. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch Dimensions.
19. AWS D1.1 - Structural Welding Code - Steel.
20. SSPC - Steel Structures Painting Council.
21. UL 580 - Underwriters Laboratories - Standard for Tests for Uplift Resistance of Roof Assemblies.
22. "Low Rise Building System Manual", Metal Building Manufacturer's Association. (MBMA).

1.4 QUALITY ASSURANCE

A. Fabrication, Erection, and Welding Qualifications:

1. Manufacturer's Qualifications: Provide a pre-engineered metal building system manufactured by a company with five (5) years' experience in manufacturing the type of pre-engineered metal building system similar to the one indicated for this project and have a record of successful in-service performance.
 - a. AISC Certification for Category MB: An AISC-certified manufacturer that designs and produces metal building systems and components in an AISC-certified facility.
 - b. The building and all its components shall be designed and detailed by the Metal Building Contractor. This contractor is responsible for submittal of the design and engineering documents for the pre-engineered metal building system, sealed by a **Professional** engineer licensed in the State in which the project is located, to the building department for review and approval.
2. Installer's Qualifications: Installer shall be certified in writing by metal building manufacturer as qualified for erection of the manufacturer's product. The installer shall have a minimum of five (5) years' experience in erection of the type of pre-engineered metal building system similar to the one indicated for this project.
3. Single Source Responsibility: Obtain the pre-engineered metal building system components, including the structural framing, wall and roof covering, and accessory components, from one single manufacturer.
4. Tolerances: Tolerances shall be as indicated by the AISC Code of Standard Practice for Buildings and Bridges, except that tolerances for fabricating, rolling, cambering and erection shall not be cumulative.

B. No substitutions will be allowed without the Architects/Engineer's approval.

C. Design Requirements:

1. Fire-Resistance Ratings: Where indicated, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to the Authorities Having Jurisdiction.
 - a. Combustion Characteristics: ASTM E136.
 - b. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - c. Metal panels shall be identified with appropriate markings of applicable testing and inspecting agency.
2. Surface-Burning Characteristics: Provide field-insulated metal panels with thermal insulation and vapor-retarder-facing materials with the following surface-burning characteristics as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to the Authorities Having Jurisdiction:
 - a. Flame-Spread Index: 25 or less, unless otherwise indicated.
 - b. Smoke-Developed Index: 450 or less, unless otherwise indicated.

1.5 COORDINATION

- A. The Contractor/Construction Manager shall coordinate the requirements of other specific building systems and other project features, including mechanical and electrical requirements, site and foundation requirements, and construction of the interior of the metal building.
- B. **Mechanical, Equipment, and Electrical** Contractors shall provide the following information to the Contractor/Construction Manager for use in the design of the pre-engineered metal building system:
 1. Dead load of all hanging items, including **pipes and equipment**.
 2. Requirements for support.
 3. Location of all roof and wall openings.
 4. Support requirements of roof and wall openings.

1.6 SYSTEM DESCRIPTION

- A. Building Description:
 1. Drawings indicate basic building layout for member sizes, profiles, dimensional requirements, lateral system locations and lateral system types. Do not modify the intended aesthetic effects or system layout without Architect/Engineer's approval. If modifications are proposed, submit comprehensive explanatory data for review.
 2. End Wall Framing:
 - a. The end wall framing shall be manufacturer's standard framing, with load bearing I-shaped columns along the wall and at the corners.

- b. Where indicated on plans, the end walls shall be designed for future expansion. Provide primary frame capable of supporting full-bay design loads, with interior columns matching adjacent bays.
- 3. Bay spacing: **As shown on the drawings.**
- 4. Roof Slope: **As shown on the drawings.**
- 5. Minimum Eave Height: **As shown on the drawings.**
- 6. Interior Wall System: Manufacturer's standard preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, non-bearing columns, and liner sheets, and accessory components.
- 7. Base Plates and Anchor Rods:
 - a. Column base plates have pinned bases that do not transfer moments to the foundations.
 - b. Base plates **shall** have a grout pad underneath the base plate.
 - c. Base plate tension forces are resisted by anchor rods. Metal building designer to design anchor rods for tension.
 - d. **Wind girt column** base plate shear forces are resisted by anchor rods. Metal building designer to design anchor rods for shear.
 - e. Rigid frame base plate shear forces are resisted by shear lugs. IMEG to design shear lugs. Refer to the drawings for additional information.
 - f. Anchor rod embedment to be designed by IMEG. Design to be completed once shop drawings are submitted with building reactions. For bid purposes, use anchor rod embedment of 12 times anchor rod diameter, unless noted otherwise.

B. Design Loads:

- 1. Building Code: **As shown on the drawings.**
- 2. Building Occupancy Category: **As shown on the drawings.**
- 3. Roof Design Dead Load:
 - a. Building Self-Weight: By metal building designer.
 - b. Superimposed Dead Load (Collateral Dead Load): **As shown on the drawings.**
 - c. Concentrated Equipment Loads: **Mechanical, Electrical, and Equipment**
Contractors shall provide the dead load weight of all hanging equipment weighing more than 100 lbs. to the Contractor/ Construction Manager for use in the design of the pre-engineered metal building system.
- 4. Live Loads:
 - a. Roof: **As shown on the drawings.**
 - b. Crane Loads: As shown on the drawings.
- 5. Snow Load:
 - a. Uniform: **Per Code.**
- 6. Wind Load:
 - a. Main Wind Force Resisting System: **As shown on the drawings.**
 - b. Components and cladding: **As shown on the drawings.**

7. Rain Load: **As shown on the drawings.**
8. Load Combinations: As required by the building code specified.
9. Deflection Criteria: Design the assemblies to withstand design loads with deflections no greater than the following:
 - a. Roof and Wall Panels: **1/180 of the span for total load.**
 - b. Purlins: **1/240** of the span for vertical total load and **1/360** of the span for vertical live load as shown on the drawings.
 - c. Girts: **1/360** of the span as shown on the drawings.
10. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on the surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (range): 120°F, ambient, 180°F material surfaces.
11. Thermal Performance: Provide metal panel assemblies with the following minimum R-values:
 - a. Thermal Resistance of Wall Insulation: Per Architect
 - b. Thermal Resistance of Roof Insulation: Per Architect

C. Design members to withstand UL 580 Uplift Class **90**.

D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

1.7 SUBMITTALS

- A. Design Calculations: Submit four (4) copies of the design calculations prepared under the direct supervision of a **Professional** engineer licensed to practice in the State in which the project is located. All copies of the calculations shall bear the engineer's state seal and signature. The calculation package shall include, but not be limited to, the following information:
 1. Load reactions for all metal building columns: Submit diagram indicating building column reactions along all three principal axes to the Contractor/Construction Manager for foundation design. Loads shall be provided as unfactored service loads and broken out into dead loads, live load, snow load, wind load, and earthquake load components.
 2. Frame analysis for all the building frames for this project: Analysis shall indicate the loads applied, the load combination used for the analysis, the member forces for all load combinations, the calculated deflections for all load combinations and the actual stress/allowable stress ratios for all load combinations.
 3. Structural analysis of the roof purlins and wall girts for the all-applied load combinations: Include calculated member deflections and forces.
 4. Allowable span tables and allowable load table for the roof and wall panels. Indicate all loads used to select the roof and wall panels.

5. Lateral force resisting system analysis indicating the member stresses, the calculated deflections, and the connection design.
 6. Anchor rod and base plate calculations for all metal building columns.
- B. Shop drawings:
1. Prepare and submit complete erection and detailed shop drawings prepared by or under the direct supervision of a **Professional** engineer legally authorized to practice in the State where the project is located for engineer's approval.
 2. Structural Framing: Shop drawings shall indicate dimensions, locations of structural members, methods of connecting, anchoring, fastening, bracing, openings, cambers, loads and support reactions.
 3. Building Accessory Components: Provide details of metal building accessory components to indicate the method of installation.
 - a. Provide details of gutters, downspouts, and other sheet metal accessories.
 - b. Provide details of all special framing, flashing, and trim required for the roof and wall openings for mechanical and electrical system components.
 4. Connection and framing details for all building frames, sidewalls, end-walls, and roof-framing members.
 5. Welder's Certification: Submit certification for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.
 6. Provide anchor rod setting plans for use by IMEG and the concrete contractor.
 7. Contractor/Construction Manager to provide copies of field concrete cylinder breaks indicating the concrete meets 75% of the design compressive strength to the steel erector.
- C. The Contractor/Construction Manager shall conduct a field survey of as-built anchors and bearing plate locations and elevations prior to steel erection. Survey shall be furnished to the steel fabricator. Contractor shall identify deviations from approved shop drawings and submit proposed repairs and modifications to the metal building manufacturer and Engineer for approval.
- D. Product Data:
1. Prepare and submit product data for Engineer's approval for **shop applied primers, finished paint system, and non-shrink grout.**
- E. Permit drawings: Submit to the building department having jurisdiction for this project, documents adequate for their review and approval, prepared by and bearing the seal of a **Professional** engineer licensed in the State in which the project is located.
- F. Color Samples: Submit to the **Owner and Architect** the manufacturer's standard color charts or chips showing the full range of colors, textures, and patterns available for the metal roofing and wall panels with factory-applied finishes.
- G. Product Samples: Provide sample panels, 12" long by actual panel width, demonstrating the panels' style, profile, color, and texture indicated for the Owner and Architect to review.

- H. Provide a letter of certification from the metal building manufacturer indicating the installer is qualified for the erection of the manufacturer's products.
- I. Maintenance Data: For **metal panel finishes and door hardware** to include in maintenance manuals.
- J. Coordinate door openings with Architect. Doors and windows are not to be provided by PEMB supplier.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Building members shall be transported, stored and erected in a manner that will avoid any damage or deformation. Materials should be stored to allow easy access for inspection and identification. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of the ground and in such a manner as to eliminate excessive handling. Bent or deformed items will be rejected and shall be replaced or repaired at the expense of the responsible party.
- B. Store fasteners in a protected location. Clean and re-lubricate bolts and nuts before use.

1.9 WARRANTIES

- A. All Components: Manufacturer's standard one (1) year workmanship warranty.
- B. Expansion Joints: A written 20-year warranty, signed by the manufacturer, agreeing to repair or replace expansion joints that fail to remain weathertight within the warranty period.
- C. Special Warranty on Standing Seam Roof Panel Weathertightness: A written 20-year warranty, signed by the manufacturer, agreeing to repair or replace standing seam roof panel assemblies that fail to remain weathertight within the specified warranty period.
- D. All warranties shall commence after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STANDARD OF QUALITY

- A. The framing system shown in the bid set for this metal building has been laid out based on the framing system manufactured by **Nucor Building Systems**, and details and specifications are based on their products.
- B. Bidders may use equivalent pre-engineered metal building system packages by the listed manufacturers, subject to the following:
 - 1. The metal building package shall consist of components and accessories as shown on the drawings and called out in these specifications, equivalent to those shown or specified. Wall and roof systems must be equivalent in appearance and performance characteristics.
 - 2. The proposed package complies with all applicable standard specifications, design standards, design loads, and design load combinations.

3. The bid shall be accompanied by a written outline of any revisions that must be made to the proposed framing layout or any other components of the total building to accommodate the metal building package of another manufacturer.
4. The cost of all revisions required to the foundations or any other building components due to the selection of an alternate manufacturer's building package shall be borne by the Contractor.

2.2 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are acceptable provided they can furnish all components that meet the specification requirements:

1. Nucor Building Systems
2. Butler Manufacturing Company
3. Ceco Building Systems
4. Behlen Buildings
5. Chief Buildings
6. Gold Seal Steel Buildings
7. As approved substitution

2.3 MATERIALS

- A. All exterior steel shall be hot dip galvanized.

- B. Structural Metal:

1. All structural metal shall be free from defects impairing strength, durability, or appearance. All structural metal shall meet the latest minimum requirements as follows:
 - a. Structural Steel Plate, Bar, Channel, Angle, Sheet, and Strip: ASTM A36; or ASTM A572, ASTM A529, or ASTM A992, Grade 50 or 55.
 - b. Structural Steel W-shapes: ASTM A529, ASTM A572, or ASTM A992, Grade 50 or 55.
 - c. Galvanized Steel Sheet: ASTM A653, structural quality, Grade 50, with G60 coating.
 - d. Aluminum Zinc-Coated Steel Sheet: ASTM A792, Grade 40.
 - e. Aluminum Coated Steel Sheet: ASTM A463.
 - f. Structural Bolts: ASTM F3125, Grade A325 or Grade A490.
 - g. Bolts for Secondary Framing: ASTM A307.
 - h. Tubing or Pipes for Structural Components: ASTM A500, Grade B.
 - i. Anchor Rods: ASTM F1554, Grade 36.
 - j. Steel Rods: ASTM A36

- C. Welding Materials:

1. All welds shall be shop welded.
2. Type required for material being welded in conformance with AWS D1.1.

2.4 STRUCTURAL FRAMING COMPONENTS

- A. Primary Framing: Shop fabricate framing components to indicate size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
1. All exterior exposed steel shall be hot dip galvanized.
 2. Make shop connections by welding or by using high-strength bolts.
 3. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
 4. Brace compression flange of primary framing with steel angles, or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 5. Weld or bolt clips to frames for attaching secondary framing members.
 6. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
- B. Secondary Framing: Shop fabricate framing components to indicate size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
1. All exterior exposed steel shall be hot dip galvanized.
 2. Make shop connections by welding or by using high-strength bolts.
 3. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.
 4. Provide manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, sag bracing, base or sill members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated.
 5. One-hour fire wall locations require girts installed at **4'-0" o.c.**
- C. Lateral Bracing Members: Provide adjustable lateral bracing as follows:
1. Rods: ASTM A36; ASTM A572, Grade 50; or ASTM A529, Grade 50; minimum 1/2-inch diameter steel; threaded a minimum of 6 inches on each end.
 2. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

2.5 GALVALUME METALWALL AND ROOF PANELS MATERIAL FINISH

- A. Factory-Applied Finish over Galvalume:
- a. 70 Percent polyvinylidene fluoride (PVDF) resin-based coating, complying with AAMA 2605 performance requirements
 - b. Resin shall be Kynar 500® or Hylar 5000®

c. Coating system shall consist of:

- 1) Pretreatment
- 2) Primer
- 3) Color coat
- 4) Clear protective topcoat

B. Manufacturer:

- a. Sherwin-Williams Fluoropon® PVDF
- b. Or approved equal meeting AAMA 2605

C. Color: As selected by Architect from manufacturer's full color range.

D. Performance Requirements: Minimum 20-year finish warranty against color fade.

2.6 ACCESSORIES

A. General: Provide accessories as standard with pre-engineered metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to the greatest extent possible by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
3. Fasteners for Metal Roof / Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
4. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Metal Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.

2. Joint Sealant: ASTM C920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by pre-engineered metal building system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify foundations are positioned correctly and the **anchor rods and shear lug blockouts** are installed as indicated on the shop drawings.
- C. For baseplates without grout, Concrete Contractor shall modify top of piers as required to get the concrete piers to the correct elevation. Contractor to submit modification procedures to the Architect/Engineer for review.

3.2 INSTALLATION- EMBEDDED ITEMS

- A. Anchor Rods:
 1. All anchor rods are to be set by the Concrete Contractor and shall be furnished promptly so they may be built in as the work progresses.
- B. Shear Lugs:
 1. Block-outs for shear lugs shall be provided in concrete foundations by Concrete Contractor, and dimensions shall be furnished so they may be built in as the work progresses.

3.3 ERECTION

- A. Bracing and Protection:
 1. The erector and not the Structural Engineer shall be responsible for the means, methods and safety of erection of the structural steel framing.
 2. Erect pre-engineered metal building system according to manufacturer's written erection instructions and erection drawings.
 3. Erection of all structural steel items shall meet the requirements of AISC "Specification and Code of Standard Practice."
 4. Steel shall be well plumbed, leveled and braced to prevent any movement.
 - a. Contractor shall provide and maintain all necessary temporary guying of the steel frame to resist safely all wind and construction loads during erection and to assure proper alignment of all parts of the steel frame.
 5. Provide all temporary bracing, shoring and guards necessary to prevent damage or injury. All partially erected metal shall be secured in an approved manner during interruptions of work.

B. Framing:

1. All work shall be erected square, plumb, straight, and true, accurately fitted and with tight joints and intersections, by mechanics experienced in the erection of metal buildings. Make allowances for the difference between the temperature at time of erection and mean temperature when the structure is completed and in service.
2. Do not field cut or alter structural members without approval of Metal Building Engineer.
3. Steel erection shall not proceed without concrete in footings, piers, and walls attaining 75% of the intended minimum compressive design strength. Documentation must be provided indicating compliance with this requirement.

3.4 For Roof and wall panels see specification section 07 41 13 (METAL ROOF AND WALL PANELS)

3.5 METAL PANEL INSTALLATION, GENERAL

A. Verify the structural panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine rough-in for components and systems penetrating metal panels to verify actual location of penetrations relative to seam locations of metal panels before metal panel installation.

B. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
2. Field cutting of metal panels by torch is not permitted.
3. Install metal panels perpendicular to structural supports, unless otherwise indicated.
4. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Lap metal flashing over metal panels to allow moisture to run over and off the material.

C. Lap-Seam Metal Panels: Install screw fasteners with power tools controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

3.6 ACCESSORY INSTALLATION

- A. Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

3.7 CLEANING, REPAIRS, PROTECTION, AND TOUCHUP

- A. Repair damaged galvanized coatings and on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field welds, final connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of the same type as shop primer used on adjacent surfaces.

3.8 COLOR SCHEDULE

See specification section 07 41 13 (METAL ROOF AND WALL PANELS) for wall and roof panel specifications and colors.

END OF SECTION

SECTION 22 05 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.
- B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.
- C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect, expressed in writing, is equal to that specified.

1.02 SCOPE OF WORK

- A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.
- B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.
- C. The approximate locations of Mechanical (HVAC) and Plumbing items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

- D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.
- E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.
- G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".
- H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

1.03 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

- A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.
- B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for approval.
- C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner.
- D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.04 SITE VISIT AND FAMILIARIZATION

- A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in

submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

- B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.
- C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.05 WORK SPECIFIED IN OTHER SECTIONS

- A. Finish painting is specified. Prime and protective painting are included in the work of this Division.
- B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) and Plumbing systems.
- C. Furnishing and installing all required Mechanical (HVAC) and Plumbing equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.06 PERMITS, TESTS, INSPECTIONS

- A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.07 DATE OF FINAL ACCEPTANCE

- A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements.
- B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

- C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe and duct shall be installed in its place promptly with no additional charge to the Owner.

1.09 NOISE AND VIBRATION

- A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.
- B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the Building structure, piping and other items.
- C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.
- D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES

- A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.
- B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.
- C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:
 - 1. Air Moving & Conditioning Association, AMCA.
 - 2. American Standards Association, ASA.
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
 - 4. American Society of Mechanical Engineers, ASME.
 - 5. American Society of Plumbing Engineers, ASPE.
 - 6. American Society of Testing Materials, ASTM.
 - 7. American Water Works Association, AWWA.
 - 8. National Bureau of Standards, NBS.
 - 9. National Fire Protection Association, NFPA.
 - 10. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
 - 11. Underwriters' Laboratories, Inc., UL.
 - 12. International Energy Conservation Code, IECC.
- D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards,

the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.

- E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

- A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.
- B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.
- C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.
- D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.
- E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.
- F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

- H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.
- I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.
- J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.
- K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.
- L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 2004 ASHRAE Fundamentals Handbook, chapter 37 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

- A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

- B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.
- C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.
- D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.
- E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 days prior to the bid date without fail.
- F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.
- G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.
- H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outline herein.
- I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) and Plumbing Design Documents and all other trades, including Division 26.

- J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected subcontractors shall be the responsibility of this bidder and not the owner.
- K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.
- L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a letter allowing the substitutions.
- M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.
- N. The electrical design and electrical drawings are based on the equipment and/or electric motors of the type, size and electrical characteristics shown and specified on the mechanical drawings. Any change in equipment and/or motor size or type brought on directly or indirectly by a substitution or mechanical equipment having characteristics requiring a change, shall be the responsibility of the Mechanical Contractor and the entire cost of such change, including conduit, wiring, motor starting equipment, etc., shall be paid for by the Mechanical Contractor at no additional charge, unless the substitution was initiated by the Owner. Submittals must clearly show and deviations. Mechanical Contractor is responsible for coordinating any required changes with the Electrical Contractor, prior to Electrical Contractors ordering of panels and associated equipment.

1.13 SUBMITTALS

- A. Coordinate with Division 1 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded the Contractor shall submit a minimum of eight (8) complete bound sets of shop drawings and complete data covering each item of equipment or material. The first submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain one (1) copy each of all shop drawings for their files. Where full size drawings are involved, submit one (1) print and one (1) reproducible sepia or mylar in lieu of eight (8) sets. All literature pertaining to an item subject to Shop Drawing submittal shall be submitted at one time. A submittal shall not contain information from more than one Specification section, but may have a section subdivided into items or equipment as listed in each section. The Contractor may elect to submit each item or type of equipment separately. Each submittal shall include the following items enclosed in a suitable binder:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
 2. An index page with a listing of all data included in the Submittal.
 3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
 4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
 5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
 6. Identification of each item of material or equipment matching that indicated on the Drawings.
 7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
 8. Additional information as required in other Sections of this Division.
 9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".
- B. Refer to Division 1 for additional information on shop drawings and submittals.
- C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.
- D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.
- E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
 2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
 3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
 4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
 5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
 6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.
- F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.
- G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.
- H. Submittals are required for, but not limited to, the following items:
1. Pipe Material and Specialties.
 2. Pipe Fabrication Drawings.
 3. Basic Materials.
 4. Variable Air Volume Boxes.
 5. Air Handling Units.
 6. Cooling Towers.
 7. Chillers.

8. Air Cooled Condensing Units.
 9. Water Treatment.
 10. Expansion Compensation.
 11. Variable Frequency Drives.
 12. Noise and Vibration Controls.
 13. Plumbing Fixtures and Specialties.
 14. Plumbing Equipment.
 15. Sanitary DWV Fittings, Pipe and Accessories.
 16. Domestic Hot and Cold Water Pipe, Fittings and Accessories.
 17. HVAC Pipe and Duct Insulation.
 18. Hydronic and Plumbing Valves.
 19. Hydronic Piping and Accessories.
 20. Hydronic Pumps.
 21. Roof-Top A/C Units.
 22. Heating Water Boiler.
 23. Portable Pipe Hanger and Equipment Supports.
 24. Duct Specialties.
 25. Duct Fabrication Drawings.
 26. Air Distribution Devices.
 27. Fan Coil Units.
 28. Filters.
 29. Fans.
 30. Fire Dampers and Fire Smoke Dampers.
 31. Temperature Controls and Control Sequences.
 32. Test, Adjust and Balance Reports.
 33. Testing, Adjusting and Balancing Contractor Qualifications.
 34. Coordination Drawings.
- I. Refer to other Division 22 sections for additional shop drawing requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.
- J. Contractor to submit Mechanical/Electrical equipment coordination sheet with equipment submittal for all AHU's, ACCU's, and Fans. Reference chart at end of section. Provide copy to electrical subcontractor.

1.14 COORDINATION DRAWINGS

- A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
 - a. Wall and type locations.
 - b. Clearances for installing and maintaining insulation.
 - c. Locations of light fixtures and sprinkler heads.

- d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - e. Equipment connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Routing of storm and sanitary sewer piping.
 - h. Fire-rated wall and floor penetrations.
 - i. Sizes and location of required concrete pads and bases.
 - j. Valve stem movement.
 - k. Structural floor, wall and roof opening sizes and details.
 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.
- B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.
- C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 22, indicate the following installed conditions:
1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 5. Contract Modifications, actual equipment and materials installed.

- B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.
- C. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.
- D. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducible is a condition of final acceptance.
- E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.
- F. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.
- G. When the option described in paragraph F., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____
(SIGNATURE)

1.16 OPERATING MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.17 CERTIFICATIONS AND TEST REPORTS

- A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.
- B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.
- C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.
- D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 22.

1.18 MAINTENANCE MANUALS

- A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in "D ring type" binders by National model no. 79-883 or equal, binders shall be large enough to allow 1/4" of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 22 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.
- B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 22, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
 2. Valve tag lists with valve number, type, color coding, location and function.
 3. Reviewed shop drawing submittals with exceptions noted compliance letter.
 4. Fabrication drawings.
 5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
 6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
 8. Equipment and motor name plate data.
 9. Wiring diagrams.
 10. Exploded parts views and parts lists for all equipment and devices.
 11. Color coding charts for all painted equipment and conduit.
 12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
 13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.
- C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.
- D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.19 OPERATOR TRAINING

- A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of on site training in three 4 hour shifts.
- B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- C. Refer to other Division 22 Sections for additional Operator Training requirements.

1.20 FINAL COMPLETION

- A. At the completion of the work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 22 for additional requirements.

- B. Clean and adjust all air distribution devices and replace all air filters immediately prior to final acceptance.
- C. Touch up and/or refinish all scratched equipment and devices immediately prior to final acceptance.

1.21 CONTRACTOR'S GUARANTEE

- A. Use of the HVAC and Plumbing systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing and if granted shall not be cause warranty period to start, except as defined below.
- B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after its completion and final acceptance, and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner or the Certificate of Final Payment as agreed upon by all parties.
- C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.
- D. All air conditioning compressors shall have parts and labor guarantees for a period of not less than 5 years beyond the date of final acceptance.
- E. Refer to Sections in Division 22 for additional guarantee or warranty requirements.

1.22 TRANSFER OF ELECTRONIC FILES

- A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.
- B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.
- C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use

of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

- D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.
- E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement between Architect and Owner.

If the client, Architect/Owner, or developer of the project requires electronic media for "record purposes", then an AutoCAD based compact disc ("CD") will be prepared. The "CD" will be submitted with all title block references intact and will be formatted in a "plot" format to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

- F. At the Architect/Owner's request, Engineer will prepare one "CD" of electronic media to assist the contractor in the preparation of submittals. The Engineer will prepare and submit the "CD" to the Architect/Owner for distribution to the contractor. All copies of the "CD" will be reproduced for a cost of reproduction fee of Five Hundred Dollars (\$500.00) per "CD".

The "CD" will be prepared and all title blocks, names and dates will be removed. The "CD" will be prepared in a ".dwg" format to permit the end user to revise the drawings.

- G. This Five Hundred Dollars (\$500.00) per "CD" cost of reproduction will be paid directly from the Contractor to the Engineer. The "CD" will be prepared only after receipt of the Five Hundred Dollars (\$500.00). The Five Hundred Dollars (\$500.00) per "CD" cost of reproduction is to only recover the cost of the manhours necessary to reproduce the documents. It is not a contractual agreement between the Contractor and Engineer to provide any engineering services, nor any other service.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide materials and equipment manufactured by a domestic United States manufacturer.
- B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.
- C. All access panels located in wet areas such as restrooms, locker rooms, shower rooms,

kitchen and any other wet areas shall be constructed of stainless steel.

D. Access Doors: shall be as follows:

1. Plastic Surfaces: Milcor Style K.
2. Ceramic Tile Surface: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

PART 3 – EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.
- B. Refer to equipment specifications in Divisions 2 through 28 for additional rough-in requirements.

3.02 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and route proposed solution to the Architect for review.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.
11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curb to match roof slope. Refer to architectural drawings and details.
14. The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.
15. The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Mechanical Equipment:
 - a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.
 - b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

3.03 CUTTING AND PATCHING

- A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.

4. Remove samples of installed Work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
 7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Section "DEFINITIONS" for definition of "Installer."
- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.04 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER

- A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:
1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
 2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

END OF SECTION 22 05 00

Plumbing/Elec. Equipment Coordination Sheet					
Mark #	Unit Type	Manufacturer's Recomm. Fuse Size (MOCP)	Mark #	Unit Type	Manufacturer's Recomm. Fuse Size (MOCP)

SECTION 22 07 00 - INSIDE UTILITY TRENCH EXCAVATION, BACKFILL, AND COMPACTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section describes general requirements, products, and methods of execution relating to excavation, backfill and compaction of inside trenches for mechanical work. Inside trenches are those which occur within an arbitrary, imaginary boundary five feet beyond the outside perimeter of the structure.
- B. Scope: Provide all trench work for mechanical work of every description and of whatever substance encountered to the depth indicated, or to provide pipe slopes and elevations shown on the drawing. Excavate and backfill utility trenches. Place and compact bedding material on compact backfill material.
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 APPLICABLE CODES

- A. Local Codes and Ordinances
- B. Texas Safety Standards
- C. OSHA – Section 1926.650

1.03 SAFETY PRECAUTIONS AND PROGRAMS

- A. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-696, 29 U.S.C. Secs. 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to enforce and comply with all of these provisions of this Act. IN ADDITION, ON PROJECTS IN WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FIVE FEET, THE CONTRACTOR AND ALL OF ITS SUBCONTRACTORS SHALL COMPLY WITH ALL REQUIREMENTS OF 29 C.F.R. SECS. 1926.652 AND 1926.653, OSHA SAFETY AND HEALTH STANDARDS.

PART 2 – BEDDING MATERIAL

2.01 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use clean sand. Maintain moisture content within a range that will allow specified compaction.

2.02 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material compatible with structural backfill is not available from trench excavation, import it from sources approved by Architect.
- B. Use granular material, free from large stones, boulders and debris. Maintain moisture content within a range that will allow specified compaction. Maximum aggregate size four inches (4").

PART 3 – EXECUTION

3.01 EXCAVATION

- A. Place all excavated material suitable for backfill in an orderly manner, and in conformance with safety codes.
- B. Dispose of all material not suitable for backfilling.
- C. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If trenches are below specified grade, backfill to required depth with select granular materials free from debris and rock, and compact to proper grade before installing piping.

3.02 LOCATION

- A. Locate trenches to accommodate utilities shown on drawings
- B. Construct trench with adequate width to allow compaction equipment to be used at the sides of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

3.03 DEWATERING

- A. Perform whatever work is necessary to prevent the flow and accumulation of surface or ground water in the excavation.

3.04 TIMING

- A. Do not backfill until underground mechanical system has been properly tested, inspected and approved.
- B. Coordinate with the work of others, and complete all trench work in a timely manner.

3.05 BEDDING

- A. Place bedding material under, around, and over the pipe in lifts not exceeding 8" in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.
- C. Cover pipe with bedding material to building subgrade or to a minimum 12" depth before adding other backfill.

3.06 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to building subgrade, or as shown on drawings.
- B. Place backfill material in lifts not to exceed 12" in depth.

3.07 COMPACTION

- A. Compact all bedding material to at least 95% of maximum density, taking care not to damage the pipe.
- B. Compact all backfill under footings, slabs, and other structures to 95% of maximum density or more, if required by the Architect.
- C. Compact other areas to preclude future settlements, or at least 85% of maximum density.

3.08 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface of grade.
- B. Do not allow heavy equipment to be used over backfilled work that does not have sufficient cover to prevent pipe damage.

3.09 SPECIAL PRECAUTIONS

- A. Avoid unauthorized and unnecessary excavations.
- B. Minimize number and size of excavations under footings or bearing walls.
- C. Support footings, foundations, and walls with timbers and jacks if there appears to be any possible chance of damage, and keep such precautions in place to eliminate possible damage.
- D. Backfill under footings and bearing walls, using maximum compaction or concrete or proportions as specified for footings.
- E. Avoid damage to all existing underground services, foundations, cables, conduit lines or foundations. Repair any existing underground work accidentally damaged at no additional cost to the Owner.

3.10 UNDER EXISTING SLAB INSTALLATION

- A. When breaking out an existing floor slab, make a saw cut and remove concrete. When repouring concrete, compact the fill to the same specifications as the building fill. Re: Architectural/Structural. Make necessary saw cuts and patching as required.

END OF SECTION 22 07 00

SECTION 22 08 00 - OUTSIDE UTILITY TRENCH EXCAVATION, BACKFILL, AND COMPACTION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Related Work Specified Elsewhere:
 - 1. Section 220500 – Basic Materials and Methods
 - 2. Division 2 – Site Work
- B. Description: This section described general requirements, products, and methods of execution relating excavation, backfill, and compaction of utility trenches outside of buildings. The arbitrary line of demarcation between inside and outside of buildings occurs 5 feet outside the building perimeters.
- C. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-696, 29 U.S.C. Secs. 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FIVE FEET, THE CONTRACTOR AND ALL OF ITS SUBCONTRACTORS SHALL COMPLY WITH ALL REQUIREMENTS OF 29 C.F.R. SECS. 1926.652 AND 1926.653, OSHA SAFETY AND HEALTH STANDARDS.
- D. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

PART 2 – PRODUCTS

2.01 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use granular material, free from large stones, boulders and debris. Maximum aggregate size passing a 2" sieve opening. Maintain moisture content within a range that will allow specified compaction.

2.02 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use granular material, free from large stones, boulders, and debris. Maintain moisture content within range that will allow specified compaction. Maximum aggregate size shall be 4 inches.

PART 3 – EXECUTION

3.01 EXCAVATION

- A. Excavate trenches to depth and grades as shown on drawings.
- B. Place all excavated material suitable for backfill in an orderly manner and in conformance with safety codes.
- C. Dispose of all material not suitable for backfill.
- D. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If ground surface is below specified pipe grade, fill to required depth with granular materials free from debris and rock, and compact to proper grade before installing piping.

3.02 LOCATION

- A. Locate trenches to accommodate utilities shown on the drawings.
- B. Construct trench with adequate width to allow compaction equipment to be used at the side of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

3.03 DE-WATERING

- A. Perform whatever work is necessary to prevent flow and accumulation of surface or ground water in the excavation.

3.04 TIMING

- A. Do not complete backfill until utility system has been properly tested, inspected, and approved.
- B. Coordinate with the work of others and complete all trench work in a timely manner.

3.05 BEDDING

- A. Place bedding material under, around, and over pipe in lifts not exceeding 8" in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and provide uniform support for the pipe.
- C. Cover pipe with bedding material to a minimum 6" depth before adding other backfill.
- D. Cover water line with 18" bedding material before backfilling.

3.06 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to finished grade, or as shown on the drawing.
- B. Place backfill material in lifts not to exceed 12" in depth.

3.07 COMPACTION

- A. Compact all bedding material to at least 95% of maximum density, taking care not to damage the pipe.
- B. Compact backfill material to preclude future settlement or at least to 90% of maximum density.

3.08 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface to grade.
- B. Restore all surface areas to original conditions, or improve as shown on the drawings.
- C. Replace all paving, base course, gravel surfacing, sub-base, topsoil or other existing finished surface shown or not shown on the drawings.
- D. Clean up and finish all construction areas to original condition or better.

END OF SECTION 22 08 00

SECTION 22 14 00 - HANGERS, SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe, and equipment hangers, supports, and associated anchors.
- B. Sleeves and seals.
- C. Flashing and sealing equipment and pipe stacks.

1.02 RELATED WORK

- A. Section 232400 - Vibration Isolation.
- B. Section 222600 - Piping Insulation.
- C. Section 232800 - Equipment Insulation.
- D. Section 211300 - Fire Protection System.
- E. Section 224100 - Plumbing System.
- F. Section 235100 - Hydronic Piping.
- G. Section 235300 – Refrigerant Piping

1.03 REFERENCES

- A. ANSI/ASME B31.1 - Power Piping.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.04 QUALITY ASSURANCE

- A. Supports for Sprinkler Piping: In conformance with NFPA 13.
- B. Supports for Standpipes: In conformance with NFPA 14.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.

- B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 to 4 Inches Carbon steel, adjustable, clevis.
- C. Hangers for Pipe Sizes 6 Inches and over: Adjustable steel yoke, cast iron roll, double hanger.
- D. All hangers, supports and rods in areas exposed to the outdoors, such as but not limited to crawl spaces, service bays, wash bays, open shops and warehouses shall be hot dipped galvanized.
- E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.
- F. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- G. Wall Support for Pipe Sizes 4 Inches and over: adjustable steel yoke and cast iron roll.
- H. Vertical Support: Steel riser clamp.
- I. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- J. Floor Support for Pipe Sizes 6 Inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- K. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable Pipe Hangers, Inc. or approved equal.

For pipes 2-1/2" and smaller – Type PP10 with roller
For pipes 3" through 8" – Type PS
For multiple pipes – Type PSE - Custom
- L. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut "Cush-A-Clamp" or equal. Hangers: Plastic coated; Unistrut or equal.
- M. For installation of protective shields refer to specification section 231400-3.03.
- N. Shields for Vertical Copper Pipe Risers: Sheet lead.
- O. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux

Chief "Pipe Titan" or equal.

2.02 HANGER RODS

- A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

- A. Metal Flashing: 20 gage galvanized steel.
- B. Lead Flashing: 4 lb./sq. ft. sheet lead for waterproofing; 1 lb./sq. ft. sheet lead for soundproofing.
- C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.
- D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.05 EQUIPMENT CURBS

- A. Fabricate curbs of hot dipped galvanized steel unless noted otherwise.

2.06 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe, schedule 40.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Form with galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- F. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.
- G. Caulk: Paintable 25-year acrylic sealant.

- H. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.07 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.08 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.01 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineer for placement of inserts.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>HANGER DIAMETER</u>
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"

4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 and over	4'-0"	5/8"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final

installation adjustments.

- J. Portable pipe hanger systems shall be installed per manufactures instructions.

3.03 Insulated Piping: Comply with the following installation requirements.

- A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
- B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
- C. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

<u>NPS</u>	<u>LENGTH</u>	<u>THICKNESS</u>
1/4 THROUGH 3-1/2	12	0.048
4	12	0.060
5 & 6	18	0.060
8 THROUGH 14	24	0.075
16 THROUGH 24	24	0.105

- D. Piping 2" and larger provide galvanized sheet metal shields with calcium silicate at hangers/supports.
- E. Insert material shall be at least as long as the protective shield.
- F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.04 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

- B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor shower mop sink and all other drains watertight to adjacent materials.
- E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.06 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermfiber and 3M caulking and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with U.L. listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Fire protection sleeves may be flush with floor of stairways.

END OF SECTION 22 14 00

SECTION 22 19 00 SYSTEM IDENTIFICATION AND PIPE MARKING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 220500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

- 1.03 Refer to Architectural Sections for additional requirements.

PART 2 - PRODUCTS

2.01 VALVE AND PIPE IDENTIFICATION

- A. Valves:
 - 1. All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.
 - 2. The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.
 - 3. Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.
 - 4. All valves shall be numbered serially with all valves of any one system and/or trade grouped together.
- B. Pipe Marking:
 - 1. All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified

with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.

2. All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton nameplate company. Factory location 20 Thompson Road, Branford, Connecticut, or approved equal.
3. Generally, markers shall be located on each side of each partition, on each side of each tee, on each side of each valve and/or valve group, on each side of each piece of equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.
4. Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.
5. Markers shall be colored as indicated below per ANSI/OSHA Standards:

<u>SYSTEM</u>	<u>COLOR</u>	<u>LEGEND</u>
Sanitary Sewer	Green	Vent Sanitary Sewer
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Re-circulating	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler

C. Pipe Painting:

1. All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

<u>System</u>	<u>Color</u>

Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Compressed Air	Green
Chilled Water Supply and Return	Light Blue

PART 3 - EXECUTION

- 3.01 All labeling equipment shall be installed as per manufacturers printed installation instructions.
- 3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractor's price shall include all items required as per manufacturers' requirements.
- 3.03 All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Install primer and a quality latex paint over all surfaces of pipe.

END OF SECTION 22 19 00

SECTION 22 26 00 PIPING INSULATION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 220500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.
- B. Work specified elsewhere.
 - 1. Painting.
 - 2. Pipe hangers and supports.
- C. All pipes subject to freezing conditions shall be insulated.

1.03 WARRANTY

- A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Mildewing.
 - 2. Peeling, cracking, and blistering.
 - 3. Condensation on exterior surfaces.

1.04 SUBMITTALS

- A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.05 DELIVERY AND STORAGE

- A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers. Containers shall be clearly labeled with the insulation's flame and smoke ratings.

PART 2 - PRODUCTS

- 2.01 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.
- 2.02 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved prior to installation.
- 2.03 A sample quantity of each type of insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.
- 2.04 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

Flame Spread 25
Smoke Developed 50

- 2.05 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.
- 2.06 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.
- 2.07 APPROVED MANUFACTURERS
 - A. Calcium silicate materials shall be as manufactured by Johns Manville.
 - B. Glass fiber materials shall be as manufactured by Johns Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

- C. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armstrong, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.
- D. Armaflex elastomeric cellular thermal insulation by Armstrong.
- E. Phenolic foam insulation shall be as manufactured by PolyPhen 2500 Insulation.
- F. Polyisocyanurate insulation shall be as manufactured by Dow "Trymer 2000 XP".
- G. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products.

2.08 MATERIALS

- A. For insulation purpose piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer well, unions, reducing stations, and orifice assemblies.
- B. INTERIOR DOMESTIC WATER PIPE: provide fiberglass pipe insulation with all service jackets with self sealing lap joint.
- C. EXTERIOR DOMESTIC WATER PIPE: Provide elastomeric cellular thermal, or preformed phenolic foam pipe insulation with secured metal jacketing.
- D. DRAIN BODIES AND DOWN SPOUTS: Insulate all horizontal roof drain down spouts, underside of all roof drain bodies, chilled water waste lines from drinking fountain to junction with main waste stacks, and branch lines including traps and exposed underside of floor drains receiving cooling coil condensate, same as water piping where exposed to building occupant view. When concealed, insulation may be same as specified for external duct wrap.
- E. CONDENSATE DRAINAGE PIPING: Fire resistant fiberglass insulation; insulation not required when piping is exposed on roof.
- F. METAL JACKETING: Utilize Childers "Strap-On" jacketing. Provide preformed fitting covers for all elbows and tees.

PART 3 - EXECUTION

- 3.01 All insulation shall be installed in accordance with the manufacturers' recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.
- 3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

- 3.03 Pipes located outdoors or in crawl spaces shall be insulated same as concealed piping; and in addition shall have a jacket of 0.016 inch thick, smooth aluminum with longitudinal modified Pittsburgh Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.
- 3.04 All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.
- 3.05 WATER PIPE INSULATION INSTALLATION
- A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, an isolating seal shall be formed between the vapor barrier jacket and the bare pipe. The seal shall be by the applications of adhesive to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.
 - B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass fiber covers finished with two brush coats of vapor barrier mastic reinforced with glass fabric.
 - C. All under lap surfaces shall be clean and free of dust, etc. before the SSL is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder shall be applied to all edges of the vapor barrier jacket.
- 3.06 FIRE RATED INSULATION
- A. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe.
 - B. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.
 - C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

PART 4 - SCHEDULES

4.01	LOW TEMPERATURE SURFACES THICKNESS	MINIMUM	INSULATION
BASED ON FIBERGLASS			
A.	Exposed exterior domestic water pipe:	1½ inch	
B.	Interior domestic cold water pipe:	1 inch	

C.	Condensate drain lines:	$\frac{3}{4}$ inch
D.	Drains receiving condensate:	1 inch
E.	Concealed horizontal leader from roof drain:	1½ inch blanket wrap
	Exposed horizontal leader from roof drain:	1 inch thick rigid (phenolic) with all service jackets

4.02 HIGH TEMPERATURE SURFACES

MINIMUM INSULATION
THICKNESS

A.	Domestic Hot Water and Hot Water Circulating Piping	1 inch

END OF SECTION 22 26 00

SECTION 22 41 00 PLUMBING, PIPING, AND VALVES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary sewer piping system.
- D. Domestic water piping system.

1.02 RELATED SECTIONS

- A. Section 022220 - Excavating.
- B. Section 022230 - Backfilling.
- C. Section 022250 - Trenching.
- D. Section 221400 - Supports and Anchors.
- E. Section 221900 – System Identification and Pipe Marking.
- F. Section 232420 - Vibration Isolation.
- G. Section 222600 - Piping Insulation.
- H. Section 224400 - Plumbing Fixtures.
- I. Section 224500 - Plumbing Equipment.

1.03 REFERENCES

- A. ANSI B31.1 - Power Piping.
- B. ANSI B31.9 - Building Service Piping.
- C. ASME - Boiler and Pressure Vessel Code.
- D. ASME Sec. 9 - Welding and Brazing Qualifications.
- E. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- F. ASME B16.3 - Malleable Iron Threaded Fittings.

- G. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- H. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- I. ASTM A47 - Ferritic Malleable Iron Castings.
- J. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- K. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- L. ASTM B32 - Solder Metal.
- M. ASTM B42 - Seamless Copper Pipe.
- N. ASTM B306 - Copper Drainage Tube (DWV).
- O. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
- P. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- Q. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- R. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- S. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- T. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
- U. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- V. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- W. AWWA C651 - Disinfecting Water Mains.
- X. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- Y. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide data on pipe materials, Pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of valves.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.07 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating cast or marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME Sec 9.
- D. Foreign pipe, fittings or valves are unacceptable.
- E. Piping shall be labeled along entire length indicating size, class, material specification, manufacturers name and country of origin.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience and must be a domestic manufacturer.
- B. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.09 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with plumbing and building codes having jurisdiction.
- B. Conform to applicable codes for the provision and installation of all required backflow prevention devices.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

- D. No PVC pipe or fittings will be allowed for any areas where pipe is to penetrate a fire rated assembly or to be installed in a return air plenum unless the entire length of all such piping is encased within a minimum 2 hour fire rated enclosure.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.01 SANITARY SOIL WASTE AND VENT PIPING, BURIED BEYOND 5 FEET OUTSIDE OF BUILDING

- A. PVC Pipe: ASTM D 1785/D 2729 schedule 40; installed per ASTM D 2321.
 - 1. Fittings: PVC, ASTM D 3311/D 2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
 - 2. Joints: solvent weld with ASTM D 2564 solvent cement, installed per the requirements of ASTM D 2855.

OR

- B. PVC pipe: ASTM D 3034, SDR 35; installed per ASTM D 2321.
 - 1. Fittings: ASTM F 1336 PVC, drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
 - 2. Joints: ASTM F 477 or F 913, elastomeric gaskets or solvent weld.

2.02 SANITARY SOIL, WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE

- A. PVC Pipe: ASTM D 1785/D 2665 schedule 40
 - 1. Fittings: PVC, ASTM D 3311/D 2665 drainage pattern, with bell and spigot ends to be furnished by the same manufacturer as pipe or approved equal.
 - 2. Joints: solvent weld with ASTM D 2564 solvent cement, clear, medium bodied, for sizes 3" and smaller and gray, heavy bodied, for sizes 4" and larger, mating surfaces shall be prepared with ASTM F 656 purple primer immediately prior to cement application.

2.03 SANITARY SOIL, WASTE AND VENT PIPING, WITHIN BUILDING, ABOVE GRADE

- A. PVC Pipe: ASTM D 1785/D 2665 schedule 40
 - 1. Fittings: PVC, ASTM D 3311/D 2665 drainage pattern, with bell and spigot ends to be furnished by the same manufacturer as pipe or approved equal.
 - 2. Joints: ASTM D 2855, solvent weld with ASTM D 2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OUTSIDE OF BUILDING

- A. Copper Pipe: ASTM B 88, Type K, hard drawn.
 - 1. Fittings: ASME B 16.18, cast bronze, or ASTM B 16.22 wrought copper alloy.
 - 2. Joints: ASTM B 32, solder.
- B. PVC Pipe: ASTM D 1785 schedule 80.
 - 1. Fittings: ASTM D 2467 PVC.
 - 2. Joints: ASTM D 2855, solvent weld with ASTM D 2564 solvent cement.
- C. PVC Pipe: ASTM D 1785 schedule 40.
 - 1. Fittings: ASTM D 2466 PVC.
 - 2. Joints: ASTM D 2855, solvent weld with ASTM D 2564 solvent cement.
- D. PVC Pipe: ASTM D 2241, SDR-26 for not less than 150 psig pressure rating.
 - 1. Fittings: ASTM D 2466 PVC.
 - 2. Joints: ASTM D 2855, solvent weld with ASTM D 2564 solvent cement.

2.05 DOMESTIC WATER PIPE, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K, soft annealed. Provide for pipe sizes up to and including 2-1/2".
 - 1. Fittings: ASTM B16.22 wrought copper pressure fittings.
 - 2. Joints shall be as follows:

- a. No joints shall be permitted for pipe sizes 2" and smaller. All such piping must be run continuous below slab on grade and brought up to no less than 12" above the finished floor before any joint is provided.
 - b. For sizes larger than 2", joints between copper pipe and fittings shall be brazed and shall be made in accordance with all the applicable portions of ASTM B828, manufacturer's recommendations, and AWS requirements. Brazing filler metal shall be in accordance with AWS A5.8 and any required flux shall meet AWS A5.31, Type FB3-A or FB3-C.
 3. Beginning at no closer than the 5'-0" mark from the building, all piping buried or in contact with concrete shall be provided with one of the following, which shall also extend to a minimum of 6" above the finished floor:
 - a. AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines. Chase Construction Products Tapecoat H35 or approved equivalent.
 - b. Continuous polyethylene lining, minimum 60 mil nominal thickness.
- B. Cross-linked Polyethylene (PEX) ASTM F877 tubing for hot and cold water distribution systems. Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency
1. ASTM F876 cross-linked polyethylene (PEX) tube, ASTM F1807 fittings and ASTM F2159 fittings.
 2. Non-barrier type.
 3. Shall have a pressure and temperature rating of 160 PSI at 73°F, 100 PSI at 180°F and 80 PSI at 200°F
 4. Tubing shall have a minimum of 6 months UV protection.
 5. Tubing shall have a 25/50 flame and smoke developed rating as per ASTM E84.
 6. Tubing shall have a 25 year warranty.
 7. Tubing shall be used with copper manifolds and nipples.

2.06 DOMESTIC WATER PIPING, WITHIN BUILDING, ABOVE GRADE:

- A. Copper Tubing: ASTM B 88, Type L, hard drawn.
1. Fittings: ASME B 16.18, cast bronze, or ASTM B 16.22 wrought copper alloy.
 2. Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy HB lead-free solder.
 3. Fittings and joints for pipe sizes 1/2" through 4" may be mechanical press-connect system joints with ASME B16.51 lead-free copper bodied fittings with integral ethylene-propylene diene monomer rubber (EPDM) sealing gaskets. All fittings, couplings, and adapters shall be the product of a single system manufacturer and only that manufacturer's approved press tools, kits, and jaws shall be used.
 - a. EPDM o-rings shall be pre-installed and lubricated with ANSI/NSF 61 listed lubricant.
 - b. All installers of copper press-connect fittings shall be trained by the fitting manufacturer's appointed representative and carry such credentials for the duration of the project.
 - c. The fitting manufacturer's representative shall conduct periodic inspections of the installation and shall provide written reports of such

inspections to the Contractor and Engineer, including any observed deviations from the manufacturer's recommended installation practices.

- d. Acceptable system manufacturers: Viega, Merit Brass, or pre-approved equal.

- B. Cross-linked Polyethylene (PEX) ASTM F877 tubing for hot and cold water distribution systems. Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third-party agency

1. ASTM F876 cross-linked polyethylene (PEX) tube, ASTM F1807 fittings and ASTM F2159 fittings.
2. Non-barrier type.
3. Shall have a pressure and temperature rating of 160 PSI at 73°F, 100 PSI at 180°F and 80 PSI at 200°F
4. Tubing shall have a minimum of 6 months UV protection.
5. Tubing shall have a 25/50 flame and smoke developed rating as per ASTM E84.
6. Tubing shall have a 25 year warranty.
7. Tubing shall be used with copper manifolds and nipples.

2.07 FLANGES AND UNIONS

- A. Drainage Applications:

1. Provide approved listed adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements.
2. For piping above ground, provide stainless steel shielded, molded elastomeric couplings and adapters meeting ASTM C564 and FM 1680. No-hub couplings shall be heavy duty type with four band stainless steel bands clamps and solid shield assembly constructed of type 300 series stainless steel.
3. For dissimilar piping above ground, provide heavy duty stainless steel shielded, molded elastomeric couplings and adapters meeting ASTM C564 and ASTM C1460. Applies to installations including cast iron to PVC transitions immediately adjacent to building slabs on grade.
4. For dissimilar underground piping not below building slab, provide shear resistant .012" thick 300 series stainless steel shielded, PVC gasketed flexible couplings and adapters meeting ASTM D5926 and ASTM C1173. For direct-bury applications, provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, to completely wrap the shield, banding, and screws. Chase Construction Products Tapecoat H35 or approved equivalent.
5. Acceptable manufacturers:
 - a. Anaco-Husky/Cremco
 - b. Mission Rubber Company LLC
 - c. Fernco, Inc.
 - d. Fernco, Inc. Strong Back RC 1000 Series (underground piping, not below building slab; or readily accessible underground piping transitions in backwater valve pits, etc.)
6. Adapters, couplings, bushings for copper DWV pipe shall be cast bronze or wrought copper, ASME B16.23/B16.29.

B. Domestic Water Applications:

1. Provide joints between various materials with approved adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements and the manufacturer's instructions.
2. For copper tube and pipe: adapters, bushings, plugs, caps, and couplings shall be wrought copper or cast bronze; flanges (minimum class 150) and unions shall be cast bronze. Provide with solder or threaded connections as necessary and as produced to applicable ASME standards B16.15, B16.18, B16.22, B16.24, B16.50, B1.20.1. All such appurtenances shall be for use in above ground potable water systems.
3. Above slab transitions for water service entries:
 - a. 100% fusion bonded epoxy coated ASTM A536 cast ductile iron construction coupling with acrylonitrile butadiene rubber (NBR) gaskets and EPDM insulating boot for water service. 5/8 inch high strength stainless steel bolts and nuts. Coupling shall meet AWWA C219. Romac Industries, Inc. IC501 or pre-approved equivalent.
 - b. 100% fusion bonded 14 mil epoxy coated coupling with ASTM A536 cast ductile iron rings. Complete with acrylonitrile butadiene rubber (NBR) gaskets and type 304 stainless steel bridge, spacers, nuts, and bolts. Coupling shall meet AWWA C219, NSF 61, and NSF 372. Krausz USA Hymax Grip Coupling Restraint or pre-approved equivalent.
4. Dielectric connections:
 - a. For pipe sizes 2 inch and smaller, provide lead-free dielectric unions, rated to 180 F at 250 psi and compliant to ASSE 1079.
 - b. For pipe sizes larger than 2 inches, provide lead-free dielectric flanged pipe fittings, rated to 180 F at 175 psi and meeting ASME B16.1.
 - c. For grooved copper joining systems, provide grooved end dielectric transition fitting from system manufacturer, with virgin polypropylene internal lining, meeting NSF 61.

C. General:

1. Unions for ferrous pipe shall be ASTM B16.39 galvanized malleable iron, threaded, minimum pressure class 150.
2. Plugs and bushings for ferrous pipe shall be ASME B16.14 galvanized malleable iron, threaded.
3. Nipples for ferrous pipe shall be schedule 40, galvanized, ASTM A53 welded steel pipe nipples, threaded, meeting ASTM A733.
4. Couplings for ferrous pipe shall be galvanized steel, threaded, manufactured in accordance with ASTM A865.
5. Flanges for ferrous pipe shall be galvanized forged steel construction, either socket weld or slip-on weld type, minimum pressure class 150, manufactured to ASME B16.5.
6. Bolts, nuts, and gaskets for flanged connections shall be appropriate to the pipe material, fluid type, temperature, and pressure. 1/16" thick pre-formed neoprene, typical.
7. Provide flexible stainless steel connectors at pumps and other such equipment, in accordance with manufacturer's recommendations. Connectors shall have corrugated hose and braided 300 series stainless steel jacketing. Carbon steel

flanged or grooved ends as appropriate. NSF 372 lead-free for all potable water applications. Metraflex Company or pre-approved equivalent.

2.08 GATE VALVES

A. Manufacturers:

1. Nibco No. T-111 up to 2-1/2"; F-617-O 3" and over.
2. Other acceptable manufacturers offering equivalent products.
 - a. Crane No. 428 up to 2-1/2"; 465-1/2 3" and over.
 - b. Stockham No. B-100 up to 2-1/2"; G-623 3" and over.
 - c. Grinnell No. 3010 up to 2-1/2"; 6020A 3" and over.

B. Up to and including 2-1/2" Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge threaded ends.

C. Over 3" Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, solid wedge, flanged ends.

D. Provide bronze tee or cast iron square nut operator for all valves installed below ground.

1. Valves 2-1/2" and smaller shall be equipped with ASTM B62 solid red bronze tee securely affixed to the valve stem.
2. Valves 3" and larger shall be equipped with a standard 2" square combination nut/socket securely affixed to the valve stem.
3. Provide owner with two extended tee handle operating wrenches for each type of valve head installed.

2.09 BALL VALVES

A. Manufacturers:

1. Nibco No. T-585-66-LF (full port) for all sizes up through 2"
2. Nibco No. T-580-66-LF (conventional port) for sizes 2-1/2" and 3"
3. Valves 4" and larger shall be split body stainless steel construction, 275psi cold working pressure, blow-out proof stem, PTFE seated, type 316 stainless steel trimmed, class 150 full port desing with manual gear operator. Nibco F-515-S6-F-66-FS
4. Other acceptable manufacturers offering equivalent products.
 - a. Apollo 70LF-140 series (full port) for all sizes up through 2".
 - b. Milwaukee UPBA-400S (full port) for all sizes up through 2".
 - c. Apollo 70LF-140 series (full port) for size 2-1/2" and Apollo 70LF-140 series (standard port) for 3".
 - d. Milwaukee UPBA-100S (standard port) for sizes 2-1/2" and 3".

B. Up to and including 2 Inches: Bronze two 600 PSI piece body full port, lead-free, stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

C. Ball valves used for balancing shall have memory stops.

2.10 SWING CHECK VALVES

A. Manufacturers:

1. Nibco No. T-413-Y-LF up to 2"; F-918-B-LF 2-1/2" and over.
2. Other acceptable manufacturers offering equivalent products.
 - a. Crane No. 37 up to 2-1/2"; 372 3" and over.
 - b. Stockham No. B-319; up to 2-1/2"; G931 3" and over.
 - c. Grinnell No. 3300 up to 2-1/2"; 6300A 3" and over.

B. Up to and including 2-1/2 Inches: Bronze swing disc, screwed ends.

C. Over 2-1/2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends. Include outside lever and adjustable weight where required for quiet operation.

2.11 SPRING LOADED (SILENT) CHECK VALVES

A. Manufacturers:

1. Nibco No. W-910
2. Other acceptable manufacturers offering equivalent products.
 - a. Grinnell No. 402

B. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer, or flanged ends.

2.12 SOLDER

A. 95.5% tin, 4% copper, 0.5% silver.

B. Lead free, antimony free, zinc-free.

C. Silvabrite 100, by Engelhard Corporation or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Coordinate and verify excavations under provisions of Division 2.

B. Verify that all excavations are to the required grade, dry, and not over-excavated.

3.02 EXCAVATION, BEDDING AND BACKFILL

A. This section shall apply for the excavation, bedding, and backfill of all buried piping unless specifically noted otherwise. All work shall be coordinated with any job site subsurface drainage/dewatering and adjusted accordingly.

- B. Establish elevations of buried piping outside the building to ensure the following:
1. Not less than 2 feet of cover, or not less than maximum depth of frost penetration, whichever is the greater.
 2. For water lines intended for fire protection service, the depth of cover shall be:
 - a. Not less than 2'-6" in those locations where frost is not a factor.
 - b. Not less than 1'-0" below the frost line for the locality.
 - c. Not less than 3'-0" for piping under driveways.
 - d. Not less than 1'-0" below the bottom of the building foundation/footers.
 - e. In full compliance with the requirements of NFPA 13 and NFPA 24.
- C. Excavation:
1. Excavate trenches for underground piping to the required depths.
 2. The bottom of the trench or excavation shall be cut to a uniform grade.
 3. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp to existing density.
 4. Coordinate alignment of pipe trenches to avoid obstructions. Ensure that proposed routing of pipe will not interfere with building foundation before any trenching has begun. Should conflicts occur, contact Architect/Engineer before proceeding.
 5. Should any sleeves through the building foundation be required, this shall be provided as directed by the structural engineer of record AND in accordance with the prevailing code, but in no case shall the sleeve be any less than two (2) pipe sizes greater than the pipe it serves.
- D. Bedding and Backfill:
1. Backfill shall not be placed until the piping has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades indicated on drawings. Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe. Provide select fill up to finished surface or grade, unless indicated otherwise by project geotechnical report or specified otherwise in Division 02.
 2. Compacting Backfill: Place material in uniform layers of 8 inches maximum, loose measure and compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 3. Restoration: Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks and similar areas, to a condition equal to the adjacent undisturbed earth and restore surface of the area to the condition existing prior to trenching or excavating operation.
 4. A clay fill "trench plug" extending 3 feet inside the building line and 5 feet outside the building line shall be placed to completely surround utility lines passing beneath the foundation and grade beam. The materials shall consist of on-site soils with a plasticity index (PI) between 20 and 30 percent compacted to at least 95 percent of the Standard Proctor and maximum dry density as determined by ASTM D-698.
- E. Cement Stabilized Sand:
1. Materials:

- a. Cement shall be Type I Portland cement conforming to ASTM C150.
 - b. Sand shall be clean, durable sand meeting grading requirements for fine aggregates of ASTM C33 and free of organic matter and deleterious substances.
 - c. Water shall be potable and free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94.
- 2. Mixture:
 - a. Product shall consist of not less than 1.5 sacks of Portland cement per ton of dry sand.
 - b. Mixture shall contain sufficient water to hydrate the cement and be thoroughly mixed in a pugmill type mixer.
- F. For water lines (including In-Building Risers) intended for fire protection service, provide joint restraints by way of concrete thrust blocks in accordance with the requirements of NFPA 13 and NFPA 24.
- G. Aggressive Soil Conditions: Soil shall be considered aggressive and protection of buried metallic piping shall be provided as specified if any of the following situations exist:
 - 1. Conditions are identified as such by the project geotechnical report or project geotechnical engineer.
 - 2. The soil environment is a landfill area, swamp, marsh, polluted river bottom, cinder bed, or has alkaline soils.
 - 3. A score of ten or higher is tallied when applying the soil assessment tool detailed in Appendix A of AWWA C105. An excerpt of this evaluation procedure is provided below for reference but is not intended as a substitute for the complete and latest Standard. The contractor shall review the Geotech report to verify if such conditions exist:

Numerical Corrosivity Scale

Soil Parameter	Assigned Points
Resistivity (ohm-cm)	
<700	10
700 – 1,000	8
1,000 – 1,200	5
1,200 – 1,500	2
1,500 – 2,000	1
>2,000	0
pH	
0 – 2	5
2 – 4	3
4 – 6.5	0

6.5 – 7.5	0
7.5 – 8.5	0
>8.5	3
Redox Potential (mV)	
>100	0

50 – 100	3.5
0 – 50	4
<0	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage continuously wet	2
Fair drainage generally moist	1
Good drainage generally dry	0

3.03 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale, oil and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install, clean bank sand backfill in trench to a minimum of 6 inches below pipe, and to cover all piping a minimum of 12 inches above pipe.

3.04 INSTALLATION

- A. Install all materials in accordance with manufacturer's published instructions.
- B. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chromium plated.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Route piping in orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.
- E. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

- F. Group piping whenever practical at common elevations.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance for installation of insulation and access to valves and fittings. Valves installed beyond reasonable reach shall be provided with chain operator.
- I. Provide access doors where valves and operable fittings are not exposed. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.
- J. Establish elevations of buried piping outside the building to ensure not less than 2 feet of cover, or maximum depth of frost penetration, whichever is the greater.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Provide encasement for and support of utility meters in accordance with requirements of utility companies.
- M. Gate valves installed below grade shall be covered with an adjustable cast iron roadway box extended to grade. Cover shall be cast iron with 'water' cast on top and set flush to finished paving or 2" above finished earthen grade. Box shall be supported from undisturbed soil or concrete base and shall not introduce any stress to piping under all traffic conditions.
- N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.
- O. Excavate in accordance with Division 2.
- P. Backfill in accordance with Division 2.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Maintain uniformity in the installation of piping materials and joining methods. Do not mix materials types.
- S. Install valves with stems upright or horizontal, not inverted.
- T. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.
- U. Installations of thermoplastic piping systems shall be in strict conformity to the manufacturers' published instructions. Underground drainage pipe installations shall be in conformity to ASTM D 2321.
- V. Installation of solvent cement joints for PVC piping shall be in strict conformity to the requirements outlined in ASTM D 2855.
- W. Waste nipple from wall to tapped tee shall be schedule 40 threaded galvanized steel pipe or brass or copper with threaded adapter.

- X. Provide approved PVC slip by cast iron no hub adaptor at each transition from underground PVC piping to above ground cast iron pipe using standard or wide bodied no hub couplings for as specified elsewhere in this section. Transition shall be made as close as possible to floor for sanitary DWV piping systems and at test tee for storm drainage piping. Support vertical cast iron pipe from floor anchors with using riser clamp and galvanized all thread rod as specified in section 231400.

3.05 APPLICATION

- A. Install union downstream of all valves at equipment or apparatus connections.
- B. Install male adapters each side of threaded valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.
- C. Install gate valves for shut-off and to isolate all equipment items, distinct parts of systems, or vertical risers.
- D. Each plumbing fixture shall have a shut-off valve on each hot water and cold water supply line.
- E. Each plumbing water rough-in stub out shall be fitted with a shut off valve.
- F. Install globe, ball or butterfly valves for throttling, bypass, or balancing (manual flow control) services.
- G. Ball valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service valve handle shall be equipped with adjustable memory stop device.
- H. Provide spring loaded, non-slam, check valves on discharge of water pumps.

3.06 ERECTION TOLERANCES

- A. All drainage lines in the building shall have 1/4 inch to the foot fall where possible and not less than 1/8 inch to the foot fall toward the main sewer. Pipe must be so laid that the slope will be uniform and continuous. Permission shall be secured from the Architect and Engineer before proceeding with any Work where existing conditions prevent the installation at minimum grade specified.
- B. Slope all water piping and arrange to drain at low points. Provide loose key operated, polished chrome, sill cock flush to wall where fixture stop will not suffice for this requirement.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

- B. Ensure 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. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.
- E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. 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.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services connecting to existing building services or utility lines as shown on the drawings.
- B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.
- C. Provide new domestic water service connecting to existing building services or utility lines as shown on plans. Assure connections are in compliance with requirements of the jurisdiction having authority.
- D. Extension of services to the building shall be fabricated from the same materials as the utility service lines or those materials specified herein.
- E. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.09 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completion of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned.

3.10 TESTING OF PLUMBING PIPING SYSTEMS

- A. During the progress of the work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.
- B. Tests shall be conducted as part of this work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.
- C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems testing shall be accomplished prior to the application of insulation.
- D. All piping systems shall be tested with water and proved absolutely tight for a period of not less than 24 hours. Tests shall be witnessed by the Architect or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.
- E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks.
- F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.
- G. Domestic Water:
 - 1. Provide hydrostatic pressure test at one and one half times the normal working pressure or 125 psig, which ever is the greater, for 24 hours.
- H. Sanitary Soil, Waste and Vents and Storm Sewer:
 - 1. After the rough-in soil, waste and vent and other parts of the sanitary sewer including branch laterals have been set from the lowest level, at point of connection to existing utility lines, to above the floor line, all outlets shall be temporarily plugged or capped, except as are required for testing as described herein. Ground work shall not permit the backfill of trenches to cover any joints until the completion of testing. Back fill shall be limited to mid sections of full joints of piping only. For pipe in ground the piping shall be readied as described herein and filled with water to a verifiable and visible level to 10' above the lowest portions of the system being tested.
 - 2. On multi-level buildings only one floor level shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the

building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.

3. Should the completion of these tests leave any reasonable question or doubt of the integrity of the installation, additional tests including peppermint smoke, or other measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.11 COMPLETE FUNCTIONING OF WORK

- A. All work fairly implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION 22 41 00

SECTION 22 43 00 PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Floor drains.
- B. Cleanouts.
- C. Backflow preventers.
- D. Water hammer arrestors.
- E. Thermostatic mixing valves.
- F. Hose bibbs hydrants.

1.02 RELATED WORK

- A. Section 221400 - Supports and Anchors.
- B. Section 224100 - Plumbing Piping.
- C. Section 224400 - Plumbing Fixtures.

1.03 REFERENCES

- A. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.
- C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- E. ANSI A112.21.1 - Floor Drains.
- F. ANSI A112.26.1 - Water Hammer Arresters.
- G. PDI WH-201 Water Hammer Arresters
- H. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

1.04 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit product data under provisions of Division 1.
- C. Include component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of equipment, cleanouts, and backflow preventers.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Operation Data: Indicate frequency of treatment required for interceptors.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

1.09 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide two loose keys for hose bibbs and spare hose end vacuum breakers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - FLOOR DRAINS

- A. Zurn
- B. Watts
- C. Jay R. Smith
- D. MiFab
- E. Substitutions: Under provisions of Division One.
- F. Floor Drains
 - 1. Lacquered cast iron floor drain with anchor flange, standard satin finish nickel bronze strainer with vandal proof stainless steel allen key screws. Provide floor drains with trap guard insert.
- G. Shower Drains
 - 1. Galvanized cast iron floor drain body with anchor flange, membrane clamp, stainless steel strainer with vandal proof stainless steel allen key screws.

2.02 ACCEPTABLE MANUFACTURERS - CLEANOUTS

- A. Zurn
- B. Watts
- C. Jay R. Smith
- D. Substitutions: Under provisions of Division 1.
- E. Cleanouts
 - 1. Exterior Surfaced Areas: Square cast nickel bronze access frame and non-skid cover;
 - 2. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover;
 - 3. Interior Finished Floor Areas: Galvanized cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable nickel-bronze strainer, round with scored cover in service areas and round with depressed cover to accept floor finish in finished floor areas;
 - 4. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and 6" round stainless steel access cover secured with machine screw;
 - 5. Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.03 ACCEPTABLE MANUFACTURERS - HOSE BIBBS/HYDRANTS

- A. Woodford

- B. Zurn
- C. Jay R. Smith
- D. Substitutions: Under provisions of Division 1.
- E. HOSE BIBBS/HYDRANTS
 - 1. Bronze or brass, replaceable hexagonal disc, hose thread spout, chrome plated where exposed to interior with lockshield and removable key, integral vacuum breaker in conformance with ANSI/ASSE 1011;
 - 2. Wall Hydrant: ANSI/ASSE 1019; non-freeze, self-draining type with rough chrome plated lockable recessed box hose thread spout, lockshield and removable key, and vacuum breaker;
 - 3. Floor Hydrant: ANSI/ASSE 1019; chrome plated lockable recessed box, hose thread spout, lockshield and removable key, and vacuum breaker;

2.04 RECESSED VALVE BOX

- A. Manufacturers:
 - 1. Oatey.
 - 2. Other acceptable manufacturers offering equivalent products.
 - 3. Sioux Chief
 - 4. Guy Gray.
 - 5. Washing Machine: Plastic preformed rough-in box with brass quarter turn ball valves and water hammer arrestors on both hot and cold connections, socket for waste, slip in finishing cover;
 - 6. Refrigerator: Plastic preformed rough-in box with quarter turn brass ball valve, slip in finishing cover;

2.05 ACCEPTABLE MANUFACTURERS - BACKFLOW PREVENTERS

- A. Watts
- B. Wilkins
- C. Febco
- D. Substitutions: Under provisions of Division 1.
- E. BACKFLOW PREVENTERS
 - 1. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks;

2. Double Check Valve Assemblies: ANSI/ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent;

2.06 ACCEPTABLE MANUFACTURERS - WATER HAMMER ARRESTORS

- A. Sioux Chief
- B. Wilkins
- C. Zurn
- D. Substitutions: Under provisions of Division 1.
- E. WATER HAMMER ARRESTORS

1. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) and maximum 250 psig (1700 kPa) working pressure;

2.07 ACCEPTABLE MANUFACTURERS - THERMOSTATIC MIXING VALVES

- A. Powers
- B. Bradley
- C. Leonard
- D. Substitutions: Under provisions of Division 1.
- E. Thermostatic Mixing Valves

1. Provide thermostatic mixing valve, with check valve, volume control shut-off valve on outlet, stem type thermometer on outlet, strainer stop check on inlet, mounted in lockable cabinet of 16 gage (1.5 mm) prime coated steel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate cutting, forming of roof and/or floor construction to receive drains to required invert elevations.

3.02 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Pipe relief from back flow preventer to nearest drain.

END OF SECTION 22 43 00

22 44 00 PLUMBING FIXTURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 220500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

- A. **WORK INCLUDED:** Include the following Work in addition to items normally part of this Section:
 - 1. Plumbing fixtures.
 - 2. Drains and cleanouts.
- B. **WORK SPECIFIED ELSEWHERE:**
 - 1. Piping systems.
 - 2. Pipe valves, and fittings.
 - 3. Plumbing systems testing.

1.03 WARRANTY

- A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noisy operation.
 - 2. Noticeable deterioration of finish.
 - 3. Leakage of water.

1.04 SUBMITTALS

- A. **SHOP DRAWINGS:** Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

- B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- C. OPERATION AND MAINTENANCE INSTRUCTIONS: Provide pre-printed operating and maintenance instructions for each item specified. Instruct and demonstrate the proper operation and maintenance to the Owner's designated representative.

1.05 DELIVERY AND STORAGE

- A. DELIVERY: Deliver clearly labeled, undamaged materials in the manufacturers' unopened containers.
- B. TIMING AND COORDINATION: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. STORAGE: Store materials in a clean, dry location, protected from weather and abuse.

1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.
- B. Confirm and field coordinate that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. PLUMBING FIXTURES:
 - 1. GENERAL: Provide plumbing fixtures as specified on drawings. The approved equal products manufacturers are as follows:
 - a. Water closet, urinals, lavatories, bath tubs and showers: American Standard, Kohler, Eljer.
 - b. Stainless steel sinks: Elkay, Just and Moen.
 - c. Mop sinks: Stern-Williams, Fiat
 - d. Faucets: American Standard, Kohler, Eljer,
 - e. Faucets: Chicago, T&S Brass, Zurn, Sloan
 - f. Faucets: Moen Commercial, Speakman
 - g. Shower valves: Leonard, Powers, Symmons, Chicago
 - h. Shower Systems: Bradley, Acorn, Willoughby
 - i. Flush Valves: Sloan "Royal", Zurn "AquaVantage"
 - j. Drinking fountains: Halsey Taylor, Elkay, Haws, Acorn Aqua.
 - k. Floor drains and roof drains: Zurn, J.R. Smith, Josam and Watts.
 - 1. Emergency Fixtures: Bradley, Chicago, Haws, Speakman and Encon
 - 2. CHAIR CARRIERS: ANSI/ASME A112.6.1.; Adjustable cast iron frame, integral

drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. As manufactured by Zurn, J. R. Smith, Josam or Watts.

3. DRINKING FOUNTAIN & URINAL WALL SUPPORTS: ANSI/ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. As manufactured by Zurn, J. R. Smith, Josam or Watts.
4. TRAPS, STOPS AND RISERS: Heavy pattern as manufactured by McGuire, Chicago or Zurn.

B. CLEANOUTS:

1. GENERAL: Provide cleanouts as shown on Drawings and as required by the city building code.
2. ACCEPTABLE MANUFACTURERS: Zurn J. R. Smith, Josam and Watts.
3. TYPES:
 - a. FINISHED FLOOR CLEANOUTS: Provide cast iron, adjustable floor level assembly with round nickel bronze top and gasket cover.
 - b. RESILIENT OR TILE FINISHED FLOOR CLEANOUTS: Provide cast iron, adjustable assembly with round nickel-bronze top with gasketed water tight cover and depressed top to receive flooring finish material.
 - c. DRY WALL CLEANOUTS: Provide cast iron tee and counter sink bronze plug with square nickel bronze frame and stainless steel cover.
 - d. Provide membrane clamp rings for slab on grade cleanouts.
 - e. All cleanouts shall have tapered bronze plugs.
 - f. All cleanouts outside of building on grade shall be set in a 18" x 18" x 4" thick concrete pad.

PART 3 - EXECUTION

3.01 PREPARATION

- A. EXAMINATION OF CONDITIONS: Examine conditions affecting this Work. Report unsatisfactory conditions to the proper authority and do not proceed until those conditions have been corrected. Commencing Work implies acceptance of existing conditions as satisfactory to the outcome of this Work.

3.02 INSTALLATION

- A. Install fixtures in locations and heights as shown on Drawings or as directed by the Architect.
- B. Install materials plumb, level, securely, and in accordance with manufacturer's recommendations.
- C. All rough-in pipe openings, for final connections with all supply waste soil and vent systems shall be closed with caps or plugs during early stages of construction and installation. Tape shall not be considered sufficient protection.

- D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.
- E. Provide gate valves in piping serving batteries of fixtures. Label stops "Hot" and "Cold." Valves to be located above accessible ceiling. If ceiling are not accessible, provide access panels of adequate size to make valves fully accessible.
- F. Plumbing fixtures shall be supported by a concealed chair carrier where required to properly support the fixture specified. All carriers to be securely mounted, bolted and checked prior to concealment.
- G. Caulk around fixtures with best grade white silicone caulking. Do not use grout.
- H. All handles on supply and drainage fittings or other brass items shall be properly lined up and adjusted. Fittings shall not be left in any haphazard manner.
- I. All fixtures shall have individual chrome plated loose key cutoff stops on supply lines. Where same are not specified as a part of the fixture trim, they shall be installed as close to fixtures as possible in the hot and cold water supply.
- J. Install each fixture with trap, easily removable for servicing and cleaning.
- K. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- L. Hot and cold water riser air chambers: Provide air chambers for hot and/or cold water riser located at the rough-in tee at all fixtures.

The air chamber shall be of the same materials and the next larger diameter than the required rough-in supply pipe and a minimum of 24" tall.

The contractor may install water hammer arrestors in lieu of air chambers. Water hammer arrestors shall be PDI Certified and sized and placed as recommended by manufacture. Provide an accessible isolation valve and proper access to arrestor for replacement.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.04 ADJUSTING

- A. Adjust work under provisions of Division 1.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

- A. Clean work under provisions of Division 1.
- B. At completion clean plumbing fixtures and equipment.

3.06 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Division 1.
- B. Do not permit use of fixtures.

3.07 ADA ACCESSIBLE FIXTURES

- A. Install fixtures to heights, indicated on architectural drawings.
- B. Handicapped fixtures shall be installed to required heights, shall be of types suitable for, and supplied with controls properly installed, to comply with requirements as directed by ADA Accessibility of Federal Registry, Part III, Department of Justice 28 CFR 36 and comply with all state and local ADA Code requirements.
- C. Exposed accessible sink or lavatory p-trap and angle valve assemblies shall be insulated with the fully molded, Truebro, Handi Lav-guard insulation kit. Provide the proper model for fixtures specified. All kits shall be White or as selected by Architect.
- D. Wall mounted drinking fountains and coolers which protrude into passages or corridor space, whether single or paired with adjacent accessible fixture, shall be supplied with skirt or apron to lower the underside clearance of non-accessible fixture equal to that required for accessible fixture.

END OF SECTION 22 44 00

SECTION 22 45 00 PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Water Heaters.
- B. In-line circulator pumps.

1.02 RELATED SECTIONS

- A. Section 221400 - Supports and Anchors.
- B. Section 232400 – Sound & Vibration Control.
- C. Section 224100 - Plumbing Piping & Valves.
- D. Section 224300 - Plumbing Specialties.
- E. Section 261800 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.03 REFERENCES

- A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- B. ASME Section VIII - Pressure Vessels; Boiler and Pressure Vessel Codes.
- C. ANSI/NFPA 54 - National Fuel Gas Code.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings:
 - 1. Include heat exchanger dimensions, size of tappings, and performance data.
 - 2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- C. Product Data:

1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, power requirements, and affected adjacent construction.
3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
4. Provide electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with authorities having jurisdiction.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 1. American Gas Association (AGA).
 2. National Sanitation Foundation (NSF).
 3. American Society of Mechanical Engineers (ASME).
 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 5. National Electrical Manufacturers' Association (NEMA).
 6. Underwriters Laboratories (UL).
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 REGULATORY REQUIREMENTS

- A. Conform to AGA NSF ANSI/NFPA 54 ANSI/NFPA 70 ANSI/UL 1453 requirements for water heaters.
- B. Conform to ASME Section VIII D for manufacture of pressure vessels for heat exchangers.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section Division 1.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

- A. Provide five year warranty under provisions of Division 1.
- B. Warranty: Include coverage of domestic water heaters, water storage tanks, and packaged water heating systems.

1.10 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide two sets of electric heater elements.

PART 2 - PRODUCTS

2.01 COMMERCIAL ELECTRIC WATER HEATERS

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. State Industries.
 - b. Bradford White.
- B. Type: Factory-assembled and wired, electric, vertical storage.
- C. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
- D. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F (16 to 82 degrees C), flanged or screw-in nickel-chrome elements, high temperature limit thermostat.
- E. Accessories: Brass water connections and dip tube, drain valve, high-density magnesium anode, and ASME rated temperature and pressure relief valve.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturer:
 - 1. Amtrol.

2. Other acceptable manufacturers offering equivalent products.
 - a. Bell & Gossett.
 - b. Armstrong.
 - c. Taco.
- B. Construction: Welded steel, tested and stamped in accordance with Section 8D of ASME Code; 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: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.03 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 1. Bell & Gossett.
 2. Other acceptable manufacturers offering equivalent products.
 - a. TACO.
 - b. Grundfos
 - c. Armstrong
- B. Casing: Bronze, rated for 125 psig working pressure.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install water heaters in accordance with manufacturer's instructions and to AGA NSF ANSI/NFPA 54 UL requirements.
- B. Coordinate with plumbing piping and related work to achieve operating system.
- C. Provide secondary drain pan and route secondary drain pipe to outside the building or as indicated on the construction documents.
- D. Route TPR drain line to the exterior of the building and terminate 6 inches above grade.
- E. Provide 18 inch high galvanized stand manufactured for supporting water heaters.

3.02 DOMESTIC HOT WATER STORAGE TANK INSTALLATION

- A. Install tanks in accordance with manufacturer's instructions.
- B. Provide steel pipe support for tanks, independent of building structural framing members.
- C. Clean and flush tank after installation. Seal until pipe connections are made.

3.03 PUMP INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
- C. Provide air cock and drain connection on horizontal pump casings.
- D. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- E. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- F. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- G. Align and verify alignment of base mounted pumps prior to start-up.

END OF SECTION 22 45 00

SECTION 23 05 00 BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.
- B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.
- C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect, expressed in writing, is equal to that specified.

1.02 SCOPE OF WORK

- A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.
- B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.
- C. The approximate locations of Mechanical (HVAC) and Plumbing items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be

installed by the Contractor under the appropriate section of work as if they were both specified and shown.

- E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.
- G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".
- H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

1.03 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

- A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.
- B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for approval.
- C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the contractor at no additional cost to the owner.
- D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.04 SITE VISIT AND FAMILIARIZATION

- A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with

this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

- B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.
- C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.05 WORK SPECIFIED IN OTHER SECTIONS

- A. Finish painting is specified. Prime and protective painting are included in the work of this Division.
- B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) and Plumbing systems.
- C. Furnishing and installing all required Mechanical (HVAC) and Plumbing equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.06 PERMITS, TESTS, INSPECTIONS

- A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.07 DATE OF FINAL ACCEPTANCE

- A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements.
- B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.
- C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe and duct shall be installed in its place promptly with no additional charge to the Owner.

1.09 NOISE AND VIBRATION

- A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.
- B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the Building structure, piping and other items.
- C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.
- D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES

- A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.
- B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.
- C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:
 - 1. Air Moving & Conditioning Association, AMCA.
 - 2. American Standards Association, ASA.
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
 - 4. American Society of Mechanical Engineers, ASME.
 - 5. American Society of Plumbing Engineers, ASPE.
 - 6. American Society of Testing Materials, ASTM.
 - 7. American Water Works Association, AWWA.
 - 8. National Bureau of Standards, NBS.
 - 9. National Fire Protection Association, NFPA.
 - 10. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
 - 11. Underwriters' Laboratories, Inc., UL.
 - 12. International Energy Conservation Code, IECC.
- D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.
- E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local

ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

- A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.
- B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.
- C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.
- D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.
- E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.
- F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.
- G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.
- H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.
- I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to

dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

- J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.
- K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.
- L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

- A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.
- B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

- C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.
- D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.
- E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 days prior to the bid date without fail.
- F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.
- G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.
- H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outline herein.
- I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) and Plumbing Design Documents and all other trades, including Division 16.
- J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected subcontractors shall be the responsibility of this bidder and not the owner.

- K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.
- L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a letter allowing the substitutions.
- M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.
- N. The electrical design and electrical drawings are based on the equipment and/or electric motors of the type, size and electrical characteristics shown and specified on the mechanical drawings. Any change in equipment and/or motor size or type brought on directly or indirectly by a substitution or mechanical equipment having characteristics requiring a change, shall be the responsibility of the Mechanical Contractor and the entire cost of such change, including conduit, wiring, motor starting equipment, etc., shall be paid for by the Mechanical Contractor at no additional charge, unless the substitution was initiated by the Owner. Submittals must clearly show and deviations. Mechanical Contractor is responsible for coordinating any required changes with the Electrical Contractor, prior to Electrical Contractors ordering of panels and associated equipment.

1.13 SUBMITTALS

- A. Coordinate with Division 1 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded the Contractor shall submit a minimum of eight (8) complete bound sets of shop drawings and complete data covering each item of equipment or material. The first submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain one (1) copy each of all shop drawings for their files. Where full size drawings are involved, submit one (1) print and one (1) reproducible sepi or mylar in lieu of eight (8) sets. All literature pertaining to an item subject to Shop Drawing submittal shall be submitted at one time. A submittal shall not contain information from more than one Specification section, but may have a section subdivided into items or equipment as listed in each section. The Contractor may elect to submit each item or type of equipment separately. Each submittal shall include the following items enclosed in a suitable binder:
 - 1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
 - 2. An index page with a listing of all data included in the Submittal.
 - 3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted

- equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
 5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of $1/4" = 1'-0"$, as required to demonstrate that the alternate or substituted product will fit in the space available.
 6. Identification of each item of material or equipment matching that indicated on the Drawings.
 7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
 8. Additional information as required in other Sections of this Division.
 9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".
- B. Refer to Division 1 for additional information on shop drawings and submittals.
- C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.
- D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.
- E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:
1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
 2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
 4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
 5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
 6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.
- F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.
- G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.
- H. Submittals are required for, but not limited to, the following items:
1. Pipe Material and Specialties.
 2. Pipe Fabrication Drawings.
 3. Basic Materials.
 4. Variable Air Volume Boxes.
 5. Air Handling Units.
 6. Cooling Towers.
 7. Chillers.
 8. Air Cooled Condensing Units.
 9. Water Treatment.
 10. Expansion Compensation.
 11. Variable Frequency Drives.
 12. Noise and Vibration Controls.
 13. Plumbing Fixtures and Specialties.
 14. Plumbing Equipment.
 15. Sanitary DWV Fittings, Pipe and Accessories.

16. Domestic Hot and Cold Water Pipe, Fittings and Accessories.
 17. HVAC Pipe and Duct Insulation.
 18. Hydronic and Plumbing Valves.
 19. Hydronic Piping and Accessories.
 20. Hydronic Pumps.
 21. Roof-Top A/C Units.
 22. Heating Water Boiler.
 23. Portable Pipe Hanger and Equipment Supports.
 24. Duct Specialties.
 25. Duct Fabrication Drawings.
 26. Air Distribution Devices.
 27. Fan Coil Units.
 28. Filters.
 29. Fans.
 30. Fire Dampers and Fire Smoke Dampers.
 31. Temperature Controls and Control Sequences.
 32. Test, Adjust and Balance Reports.
 33. Testing, Adjusting and Balancing Contractor Qualifications.
 34. Coordination Drawings.
- I. Refer to other Division 23 sections for additional shop drawing requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.
- J. Contractor to submit Mechanical/Electrical equipment coordination sheet with equipment submittal for all AHU's, ACCU's, and Fans. Reference chart at end of section. Provide copy to electrical subcontractor.

1.14 COORDINATION DRAWINGS

- A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
 - a. Wall and type locations.
 - b. Clearances for installing and maintaining insulation.
 - c. Locations of light fixtures and sprinkler heads.
 - d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - e. Equipment connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Routing of storm and sanitary sewer piping.
 - h. Fire-rated wall and floor penetrations.
 - i. Sizes and location of required concrete pads and bases.

- j. Valve stem movement.
 - k. Structural floor, wall and roof opening sizes and details.
 - 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.
- B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.
- C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 23, indicate the following installed conditions:
- 1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
 - 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
 - 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - 5. Contract Modifications, actual equipment and materials installed.
- B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.
- C. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

- D. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.
- E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.
- F. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.
- G. When the option described in paragraph F., above is not exercised then upon completion of the work, the Contractor shall transfer all marks from the submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY: _____
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY: _____
(SIGNATURE)

1.16 OPERATING MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.17 CERTIFICATIONS AND TEST REPORTS

- A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.
- B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.
- C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.
- D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 23.

1.18 MAINTENANCE MANUALS

- A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in "D ring type" binders by National model no. 79-883 or equal, binders shall be large enough to allow 1/4" of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 23 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.
- B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 23, include the following information for equipment items:
 1. Identifying names, name tags designations and locations for all equipment.
 2. Valve tag lists with valve number, type, color coding, location and function.
 3. Reviewed shop drawing submittals with exceptions noted compliance letter.
 4. Fabrication drawings.
 5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.

6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
 8. Equipment and motor name plate data.
 9. Wiring diagrams.
 10. Exploded parts views and parts lists for all equipment and devices.
 11. Color coding charts for all painted equipment and conduit.
 12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
 13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.
- C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.
- D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.19 OPERATOR TRAINING

- A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of on site training in three 4 hour shifts.
- B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- C. Refer to other Division 23 Sections for additional Operator Training requirements.

1.20 FINAL COMPLETION

- A. At the completion of the work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 23 for additional requirements.
- B. Clean and adjust all air distribution devices and replace all air filters immediately prior to final acceptance.
- C. Touch up and/or refinish all scratched equipment and devices immediately prior to final acceptance.

1.21 CONTRACTOR'S GUARANTEE

- A. Use of the HVAC and Plumbing systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing and if granted shall not be cause warranty period to start, except as defined below.
- B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after its completion and final acceptance, and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner or the Certificate of Final Payment as agreed upon by all parties.
- C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.
- D. All air conditioning compressors shall have parts and labor guarantees for a period of not less than 5 years beyond the date of final acceptance.
- E. Refer to Sections in Division 23 for additional guarantee or warranty requirements.

1.22 TRANSFER OF ELECTRONIC FILES

- A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.
- B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.
- C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.
- D. Any reuse or modifications will be Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.
- E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement between Architect and Owner.

If the client, Architect/Owner, or developer of the project requires electronic media for "record purposes", then an AutoCAD based compact disc ("CD") will be prepared. The "CD" will be submitted with all title block references intact and will be formatted in a "plot" format to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

- F. At the Architect/Owner's request, Engineer will prepare one "CD" of electronic media to assist the contractor in the preparation of submittals. The Engineer will prepare and submit the "CD" to the Architect/Owner for distribution to the contractor. All copies of the "CD" will be reproduced for a cost of reproduction fee of Five Hundred Dollars (\$500.00) per "CD".

The "CD" will be prepared and all title blocks, names and dates will be removed. The "CD" will be prepared in a ".dwg" format to permit the end user to revise the drawings.

- G. This Five Hundred Dollars (\$500.00) per "CD" cost of reproduction will be paid directly from the Contractor to the Engineer. The "CD" will be prepared only after receipt of the Five Hundred Dollars (\$500.00). The Five Hundred Dollars (\$500.00) per "CD" cost of reproduction is to only recover the cost of the manhours necessary to reproduce the documents. It is not a contractual agreement between the Contractor and Engineer to provide any engineering services, nor any other service.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide materials and equipment manufactured by a domestic United States manufacturer.
- B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.
- C. All access panels located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- D. Access Doors: shall be as follows:
1. Plastic Surfaces: Milcor Style K.
 2. Ceramic Tile Surface: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect.

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.
- B. Refer to equipment specifications in Divisions 2 through 16 for additional rough-in requirements.

3.02 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and route proposed solution to the Architect for review.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.
 - 11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified.
 - 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curb to match roof slope. Refer to architectural drawings and details.
14. The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.
15. The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Mechanical Equipment:
 - a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.
 - b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

3.03 CUTTING AND PATCHING

- A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed Work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
 7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Section "DEFINITIONS" for definition of "Installer."

- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.04 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER

- A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:
 - 1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
 - 2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

END OF SECTION 23 05 00

Mech/Elec. Equipment Coordination Sheet					
Mark #	Unit Type	Manufacturer's Recomm. Fuse Size (MOCP)	Mark #	Unit Type	Manufacturer's Recomm. Fuse Size (MOCP)

SECTION 23 05 10 STARTING OF SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Starting systems.
- B. Demonstration and instructions.
- C. Testing, adjusting, and balancing.

1.02 RELATED SECTIONS

- A. Section 014000 - Quality Control: Manufacturers field reports.
- B. Section 017000- Contract Closeout: System operation and maintenance data and extra materials.
- C. Section 239900 - Testing, Adjusting and Balancing.

1.03 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect, Engineer and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Adjust electrical amp draw on motors to within 80% of rated amp draw.
- F. Verify wiring and support components for equipment are complete and tested.
- G. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.
- H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

- I. Adjust return air to 500 fpm at each air unit inlet. Replace drive packages as necessary to achieve design airflows.
- J. Submit a written report in accordance with Section 014000 that equipment or system has been properly installed and is functioning correctly.

1.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of final inspection.
- B. Demonstrate Project equipment and provide instruction by a qualified manufacturers' representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.05 TESTING, ADJUSTING, AND BALANCING

- A. Mechanical Division will secure the services of an independent firm to perform testing, adjusting, and balancing.
- B. The independent firm will perform services specified in Section 239900.
- C. Reports will be submitted by the independent firm to the Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 23 05 10

STARTING OF SYSTEMS

23 05 10 - 2

SECTION 23 07 19 - DIRECT EXPANSION PIPING SYSTEM INSULATIONS

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 insulating the following HVAC piping systems.
 - 1. Refrigerant suction (low pressure gas) piping.
 - 2. Refrigerant hot gas (discharge or high pressure gas) piping.
 - 3. Refrigerant liquid piping, for VRF/VRV and Heat Pump systems.
 - 4. Condensate drainage piping.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include thermal conductivity, water vapor permeance, thickness, and jackets (both factory and field applied if any).

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualification: Only trained installers that are familiar with the products should be used.

1.06 DELIVERY STORAGE AND HANDLING

- A. Material to be delivered in new condition, free of defects and stored in a clean, dry space that provides protection against damage and contamination.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 231400 "Hangers and Supports for HVAC Piping and Equipment".
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and space required for

maintenance.

1.08 SCHEDULING

- A. Schedule insulation application after pressure testing and leak testing of systems. Insulation application may begin on segments that have satisfactory test results.

Part 2 – PRODUCTS

2.01 INSULATION MATERIALS

- A. Flexible Elastomeric Foam: EPDM - Closed cell expanded rubber. Comply with ASTM C 534, Type I for tubular materials for refrigeration pipe sizes 1/4" and greater.
 - 1. Outdoor Use, Basis of Design Product: Provide Reftekk AC-SSPT (EPDM pre-split with lap seal and field applied Aeroflex Aerocoat) or comparable product by one of the following.
 - a. Aeroflex, EPDM SSPT with field applied Aerocel Aerocoat
 - b. Armacell, LLC, EPDM UT Solaflex, Pre-split with lap seal and with field applied Black PVC jacket
 - 2. Indoor Use, Basis of Design Product: Provide Reftekk AC-SSPT (EPDM pre-split with lap seal) or comparable product by one of the following.
 - a. Aeroflex, EPDM SSPT
 - b. Armacell, LLC, EPDM UT Solaflex, Pre-split with lap seal
 - 3. Applied to Annealed Coiled Tubing (Line Sets), Basis of Design Product: EPDM continuous tube.
- B. Elastomeric insulation shall not use CFC's or HFC's in the manufacturing process.
- C. Elastomeric insulation shall have a flame spread-index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E84 for all products through 2" thickness.
- D. Elastomeric insulation and elastomeric joining system shall be suitable of use from -70°F to 257°F continuous service temperature, per ASTM C 411.
- E. Elastomeric insulation shall have a maximum thermal conductivity of 0.235 Btu-in/h-ft²-°F at a mean temperature of 75°F when tested in accordance with ASTM C 177 or ASTM C 518.
- F. Elastomeric insulation shall have a maximum water vapor transmission of ≤0.03 perm-inch when tested in accordance with ASTM E 96, Procedure A, latest revision.
- G. Elastomeric insulation must exhibit long-term UV resistance in outdoor installation per ASTM G 7 and ASTM G 90.
- H. Elastomeric insulation must not contribute to external stress corrosion cracking when tested per ASTM C 692.

2.02 ADHESIVES, AND TAPES

- A. Flexible Elastomeric Adhesive for Indoor and Outdoor Application:
 - 1. Basis of Design Product: Provide Aeroflex AeroSeal contact adhesive or comparable product by one of the following.
 - a. Armacell, LLC HT 625 contact adhesive
- B. Flexible Elastomeric for LEED low VOC Application:
 - 1. Basis of Design Product: Provide Aeroflex AeroSeal LVOC
- C. Seaming tape to be 15-mil EPDM rubber with acrylic adhesive.

2.03 INSULATING PIPE HANGER SUPPORTS

- A. Support the piping system using high density rigid foam insulating pipe hanger supports with an inner lining of EPDM rubber insulating tape and 15-mil exterior EPDM rubber jacket. Insulation density to be a minimum of 10 lb. / cu. ft. with a compressive strength of 284 PSI or greater, and a k-value of 0.312 or lower. Continuous use temperature range to be -70°F to 257°F with water absorption of 5% or less.
 - 1. Basis of Design Product: Provide Reftekk “Cush-A-Therm”, model UX insulated pipe support complete with steel channel insulation OD clamp or comparable product by one of the following.
 - a. Aeroflex USA, Aerofix-U with matching steel channel insulation OD clamp.
 - b. Armaflex LLC, Armafix IPH with matching steel channel insulation OD clamp.

2.04 METAL JACKETING

- A. Childers “Strap-On” jacketing. Provide preformed fitting covers on all elbows and tees.

Part 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and free of leaks and defects
 - 2. Verify that surfaces to be insulated are clean, dry and free of dirt, dust, grease, frost, and moisture.
 - 3. Work shall be performed at the installation temperatures recommended by the product manufacturer.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Tape seams and lap seam tape overlaps shall be clean dry, free of dirt, dust, grease, frost and moisture.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. All piping, valves and fittings scheduled to be insulated to have all insulation applied in strict accordance with the insulation manufacturers installation instructions and practices described in the National Commercial and Industrial Insulation Standards Manual. In case of conflict, the manufacturers installation guidelines and instruction will be used.
- B. Install insulation materials, accessories and finishes with smooth, straight, and even surfaces; free of voids, throughout the length of the piping including supports, fittings, valves and specialties.
- C. Pipes located outdoors or in crawl spaces shall be insulated same as concealed piping; and in addition shall have a jacket of 0.016 inch thick, smooth aluminum with longitudinal modified Pittsburgh Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.
- D. Install insulation materials, vapor barriers, vapor dams, jackets, and thicknesses required for each item of the pipe system as required.
- E. Install insulation with longitudinal seams oriented per the insulation manufacturers installation instructions for all horizontal runs.
- F. Keep insulation dry and clean during application and finishing. Do not apply insulation to operating systems.
- G. Install insulation with the least number of joints practical.
- H. Piping to be insulated with tubular preformed pipe insulation.
- I. Install insulation continuously through roof penetrations, wall penetrations and floor penetrations.
- J. Install insulation continuously through fire rated wall and fire rated floor penetrations complying with Penetration Fire-stopping details.
- K. Insulating Pipe Hanger Supports are to be installed at all pipe support and clamp locations. Insulating Pipe Hanger Supports are to be installed at the time of piping installation such that the pipe insulation system is installed in a continuous manner through the pipe support system.
- L. All insulation terminations, butt joints, longitudinal joints, and access points to be properly glued or sealed with the insulation manufacturers sealant system.
- M. Vapor dams to be installed every 12' to 18' per insulation manufacturers installation instructions, high point of piping run and at all insulation terminations (supports, valves, flanges and end of pipe runs)
- N. Provide sufficient clearance between insulated pipes to allow air circulation.
- O. Provide mitered insulation fittings at elbows to prevent compression of the insulation at the throat of the elbow and stretching on the outside of the bend.
- P. Do not compress the insulation at penetrations or structural members, such as joists or studs. Do not allow the insulation to be compressed by ceiling hanger wires.
- Q. Do not allow attachment of anything to the insulated piping that will reduce the effective thickness of the insulation, such as control wiring, cabling, telephone wiring, etc. When using insulation manufacturers recommended tape on joints, do not compress the insulation.

- R. Insulation should be installed such that butt joints are in slight compression. This prevents separation of the insulation joints over time or due to changes in temperature. Do NOT apply the insulation in a stretched condition.
- S. Insulation thickness to be the most restrictive of the following options.
 - 1. Liquid, suction, and discharge lines per state energy codes.
 - 2. In accordance with the thickness tables for piping insulation in the latest version of ASHRAE 90.1.
 - 3. In accordance with local building code requirements and Authority Having Jurisdiction.
 - 4. In accordance with the requirements of the manufacturers of the equipment being served by the insulated refrigerant piping system.
 - 5. Sufficient thickness to prevent condensation on the surface of the insulation under all operating conditions.

PART 4 - SCHEDULES

4.01	LOW TEMPERATURE SURFACES	MINIMUM INSULATION THICKNESS BASED ON FIBERGLASS
A.	Condensate drain lines:	¾ inch
B.	Drains receiving condensate:	1 inch
C.	Refrigerant Piping	
	(1) 1½“ and smaller	1 inch
	(2) Larger than 1½ inch	1 inch

END OF SECTION 23 07 19

SECTION 23 14 00 SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe, and equipment hangers, supports, and associated anchors.
- B. Sleeves and seals.
- C. Flashing and sealing equipment and pipe stacks.

1.02 RELATED WORK

- A. Section 23 24 00 – Sound and Vibration Control.
- B. Section 23 26 00 - Piping Insulation.
- C. Section 23 28 00 - Equipment Insulation.
- D. Section 22 41 00 - Plumbing System.
- E. Section 23 55 10 - Hydronic Piping Above Grade.
- F. Section 23 55 11 – Hydronic Piping Below Grade.
- G. Section 23 53 00 – Refrigerant Piping

1.03 REFERENCES

- A. ANSI/ASME B31.1 - Power Piping.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.04 QUALITY ASSURANCE

- A. Supports for Sprinkler Piping: In conformance with NFPA 13.
- B. Supports for Standpipes: In conformance with NFPA 14.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 to 4 Inches Carbon steel, adjustable, clevis.
- C. Hangers for Pipe Sizes 6 Inches and over: Adjustable steel yoke, cast iron roll, double hanger.
- D. All hangers, supports and rods in areas exposed to the outdoors, such as but not limited to crawl spaces, service bays, wash bays, open shops and warehouses shall be hot dipped galvanized.
- E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.
- F. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- G. Wall Support for Pipe Sizes 4 Inches and over: adjustable steel yoke and cast iron roll.
- H. Vertical Support: Steel riser clamp.
- I. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- J. Floor Support for Pipe Sizes 6 Inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- K. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable Pipe Hangers, Inc. or approved equal.
 - For pipes 2-1/2" and smaller – Type PP10 with roller
 - For pipes 3" through 8" – Type PS
 - For multiple pipes – Type PSE - Custom
- L. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut "Cush-A-Clamp" or equal. Hangers: Plastic coated; Unistrut or equal.
- M. For installation of protective shields refer to specification section 231400-3.03.
- N. Shields for Vertical Copper Pipe Risers: Sheet lead.
- O. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief "Pipe Titan" or equal.

2.02 HANGER RODS

- A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

- A. Metal Flashing: 20 gage galvanized steel.
- B. Lead Flashing: 4 lb./sq. ft. sheet lead for waterproofing; 1 lb./sq. ft. sheet lead for soundproofing.
- C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.
- D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.05 EQUIPMENT CURBS

- A. Fabricate curbs of hot dipped galvanized steel unless noted otherwise.

2.06 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe, schedule 40.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Form with galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- F. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.
- G. Caulk: Paintable 25-year acrylic sealant.
- H. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.07 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.08 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.01 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineer for placement of inserts.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>HANGER DIAMETER</u>
(Steel Pipe)		
1/2 to 1-1/4 inch	6'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
(Copper Pipe)		

1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 and over	4'-0"	5/8"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.
- J. Portable pipe hanger systems shall be installed per manufactures instructions.

3.03 Insulated Piping: Comply with the following installation requirements.

- A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
- B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
- C. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

<u>NPS</u>	<u>LENGTH</u>	<u>THICKNESS</u>
1/4 THROUGH 3-1/2	12	0.048
4	12	0.060
5 & 6	18	0.060
8 THROUGH 14	24	0.075
16 THROUGH 24	24	0.105

- D. Piping 2" and larger provide galvanized sheet metal shields with calcium silicate at hangers/supports.
- E. Insert material shall be at least as long as the protective shield.
- F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.04 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

- D. Seal floor shower mop sink and all other drains watertight to adjacent materials.
- E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.06 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermfiber and 3M caulking and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with U.L. listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Fire protection sleeves may be flush with floor of stairways.

END OF SECTION 23 14 00

SECTION 23 24 00 SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Vibration and sound control products.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division One specification sections, apply to work of this section
- B. This section is Division 23 Basic Materials and Methods section, and is part of each Division 23 section making reference to vibration control products specified herein.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.
- C. Except as otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.04 SUBMITTALS

- A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Amber/Booth Company, Inc.
- B. Mason Industries, Inc.
- C. Kinetics Noise Control, Inc.

2.02 GENERAL

- A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structures that may cause discomfort to the occupants.
- B. Model numbers of Amber/Booth products are included for identification. Products of the additional manufacturers will be acceptable provided they comply with all of the requirements of this specification.

2.03 FLOOR MOUNTED AIR HANDLING UNITS

- A. Provide Amber/Booth CAL-2, style C aluminum housed isolators sized for 2" static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication
- B. If floor mounted air handling units are furnished with internal vibration isolation option, provide 2" thick Amber/Booth type NRC ribbed neoprene pads to address high frequency breakout and afford additional unit elevation for condensate drains. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer's recommendations.

2.04 SUSPENDED AIR HANDLING UNITS

- A. Provide Amber/Booth type BSWR-2 combination spring and rubber-in-shear isolation hanger sized for 2" static deflection.
- B. If suspended air handling units are furnished with internal vibration isolation option, furnish Amber/Booth type BRD rubber-in-shear or NR AMPAD 3/8" thick neoprene pad isolation hangers sized for approximately 1/2" deflection to address high frequency breakout.

2.05 SUSPENDED FANS AND FAN COIL UNITS

- A. Provide Amber/Booth type HS spring hangers sized for 1" static deflection.

2.06 PIPING

- A. Provide spring and rubber-in-shear hangers, Amber/Booth type HRS in mechanical equipment rooms, for a minimum distance of 30 feet from isolated equipment for all chilled water and hot water piping 1-1/2" diameter and larger. Springs shall be sized for 1" deflection.
- B. Floor supported piping is required to be isolated with Amber/Booth type AW-1 open springs sized for 1" deflection.

- C. Furnish line size flexible connectors at supply and return of pumps, Amber/Booth style 2800 single sphere EPDM construction, connector shall include 150 lb. cadmium plated carbon steel floating flanges.

2.07 CORROSION PROTECTION

- A. All vibration isolators shall be designed and treated for resistance to corrosion.
- B. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

- 3.01 All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- 3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.
- 3.03 If internal isolation option is used on air handling units, the mechanical contractor shall verify proper adjustment and operation of isolators prior to start-up. All shipping brackets and temporary restraint devices shall be removed.
- 3.04 The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION 23 24 00

SECTION 23 29 00 DUCT INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Ductwork system insulation.

1.02 RELATED SECTIONS

- A. Section 230500 - Basic Materials and Methods
- B. Section 231700 - Motors and Motor Controllers

1.03 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
- C. Duct and plenum insulation shall comply with minimum R-value requirements of the latest edition of the International Energy Conservation Code.
- D. Adhesive and other material shall comply with NFPA and NBFU Standards No. 90A and 90B.

1.04 SUBMITTALS

- A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories. Provide 8x11 sample of product along with submittal.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in unopened containers with manufacturer's stamp, clearly labeled with flame and smoke rating,

affixed showing fire hazard indexes of products.

- B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 GENERAL DESCRIPTION

- A. The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved before any insulation is installed.
- B. A sample quantity of each type of insulation and each type of application shall be installed and approval secured prior to proceeding with the main body of the work.

2.02 ACCEPTABLE MANUFACTURERS

- A. Glass fiber materials shall be manufactured by Knauf, Certain-Teed, Johns-Manville or Owens-Corning and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.
- B. Adhesives shall be manufactured by Minnesota Mining, Arabol, Benjamin-Foster, Armstrong or Insulmastic, Inc., and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.
- C. Ceramic fiber materials shall be as manufactured by Primer Refractories, A.P. Green Refractories or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. All insulation shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

3.02 EXTERNAL DUCT INSULATION

- A. Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" wide apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.
- B. Seal all seams and joints, fastener penetrations and other breaks in vapor barrier with 3 inch wide strips of white glass fabric embedded between two coats of vapor barrier mastic, Childers CP-30 or approved equal.

- C. All external duct insulation shall be Knauf Insulation Atmosphere Duct Wrap with ECOSE Technology, Johns Manville Microlite EQ duct wrap insulation with reinforced aluminum facing or approved equal.
- D. External duct wrap is required on all outside air ducts, supply and return air ducts that are not internally insulated. External duct wrap is also required on all exhaust and relief air ducts that are used in airside energy recovery systems. Any exhaust ductwork located in an unconditioned space shall also be provided with external duct wrap. Duct wrap shall be provided as follows:
 - 1. A minimum installed R-value of 6 when ducts are located in conditioned and unconditioned spaces, such as ceiling plenum space.
 - 2. A minimum installed R-value of 8 when ducts are located outside of the building.
- E. Any ductwork located in an air plenum that is comprised of materials that do not comply with the 25/50 flame and smoke rating per ASTM E 84 testing requirements shall be provided with a single layer of duct wrap to establish a noncombustible rating per ASTM E 136. Duct wrap products which are approved for such non-compliant combustible duct materials located in air plenums shall be 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum. Insulation products for this application shall be installed in strict accordance with the manufacturer's instructions.

3.03 DUCT LINER

- A. Duct liner shall be kept clean and dry during transportation, storage, installation, and throughout the construction process care should be taken to protect the liner from exposure to the elements or damage from mechanical abuse.
- B. All portions of duct designed to receive duct liner shall be completely covered with liner as specified. The smooth, black, mat facing or acrylic-coated surfaces with flexible glass cloth reinforcement shall face the airstream. All duct liner shall be cut to assure tight, overlapped corner joints. The top pieces shall be supported by the sidepieces. Duct liner shall be installed following the guidelines in the NAIMA "Duct Liner Installation Standard".
- C. The duct liner shall be tested according to erosion test method in ASTM C 1071 and shall be guaranteed to withstand velocities in the duct system up to 6000 fpm without surface erosion.
- D. Duct liner shall be adhered to the sheet metal with full coverage of an approved adhesive that conforms to ASTM C 916, and all exposed leading edges and transverse joints shall be coated with Permacote factory-applied or field-applied edge coating and shall be neatly butted without gaps. Shop or field cuts shall be liberally coated with Johns Manville SuperSeal[®] duct butter and Edge Treatment or approved adhesive.
- E. Metal nosings shall be securely installed over transversely oriented liner edges facing the airstream at forward discharge and at any point where lined duct is preceded by unlined duct.

- F. When velocity exceeds 4000 fpm (20.3 m/sec), use metal nosing on every leading edge. Nosing may be formed on duct or be channel or zee attached by screws, rivets or welds.
- G. The liner shall further be secured with Graham welding pins and washers on not more than 18 inch centers both vertical and horizontal surfaces, and the pins and washers shall be pointed up with adhesive.
- H. Duct liner shall be Knauf Insulation Atmosphere Duct Liner with ECOSE Technology, Johns Manville Linacoustic RC duct liner with factory-applied edge coating and acrylic coating on the mat surface of airstream side or approved equal. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B, FHC 25/50 and Limited Combustibility and the air stream surface coating should contain an immobilized, EPA-registered, anti-microbial agent so it will not support microbial growth as tested in accordance with ASTM G21 and G22. The duct liner shall conform to the requirements of ASTM C 1071, UL 2824, with an NRC not less than .70 as tested per ASTM C 423 using a Type "A" mounting, and a thermal conductivity no higher than 0.24 BTU•in/(hr•ft²•°F) at 75°F mean temperature.
- I. Line supply and return ductwork at connection of HVAC unit to a point of 15 feet upstream and downstream of the equipment and in return air boots. Attach with full cover coat of cement, duct dimensions up to 16 inches; provide stick clips or screws and cap for dimensions over 16 inches, spaced 16 inches o.c. maximum. Provide sheet metal liner cap over all leading edges of internal insulation exposed to air stream.
- J. Duct liner shall be provided as follows:
 - 1. Minimum installed R-value of 6 when ducts are located in conditioned spaces.
 - 2. Minimum installed R-value of 6 when ducts are located in unconditioned spaces, such as ceiling plenum space.
 - 3. Minimum installed R-value of 12 or greater when ducts are located outdoors.

3.04 EXPOSED DUCTWORK LOCATED INDOORS

- A. Round duct routed exposed shall be double wall with solid inner liner and R-6 thermal insulation as manufactured by United McGill Company model no. Acousti-27 or approved equal. Insulation density shall be a minimum of 1.5 PCF.

3.05 AIR DEVICE AND MISCELLANEOUS DUCT INSULATION

- A. The backside of all supply air devices shall be insulated with taped and sealed with external duct wrap equivalent to the insulation specified.
- B. The contractor shall install an additional layer of 2 inch thick external fiberglass duct wrap on any portion of the supply air, return air, outside air, or exhaust air system that has condensation forming during any period of operation. The insulation shall be taped and sealed and located until all evidence of the condensation had been eliminated at no additional cost to the owner.

3.06 KITCHEN GREASE HOOD EXHAUST DUCT

- A. All type I kitchen range hood exhaust duct shall be enclosed with 2-hour fire rated enclosure.
- B. The duct enclosure shall be sealed around the duct at the points of penetration with an approved fire barrier sealant per ASTM E 1966. Sealant shall be 3M CP 25WB+ or 303 fire barrier caulk and putty.
- C. The enclosure shall be separated from the duct by at least 3 inches and not more than 12 inches.
- D. Cleanout openings at exhaust duct with access openings at the fire rated enclosure and access doors shall be provided at each duct offset and as required for proper operation and maintenance.
- E. As an alternate method, the contractor may use two layers of 2-hour fire rated duct wrap such as 3M Fire Barrier Duct Wrap 615+ or Unifrax FyreWrap Elite 1.5 in lieu of the fire rated enclosure, provided that all the following constraints are satisfied:
 - a. Duct wrap system shall be tested per ASTM E 2336 internal fire testing and have an achieved minimum fire resistance rating of 2 hours.
 - b. Product shall be approved by the local Authority Having Jurisdiction (AHJ).
 - c. Duct wrap system shall be mechanically attached to the duct using steel banding and/or weld pins per manufacturer's instructions.
 - d. Duct wrap system shall be installed in strict accordance with the manufacturer's instructions, including but not limited to zero clearance to combustibles at all locations on the wrap surface.
- F. Insulation and all other requirements shall be provided per local codes.

END OF SECTION 23 29 00

SECTION 23 53 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 230500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

PART 2 - PRODUCTS

2.01 GENERAL

Provide for the systems as shown. Submit shop drawings of piping systems showing all traps, pipe sizes, and accessories; drawing to be marked "Approved", and signed by a representative of the Application Engineering Department of the condensing unit manufacturer. Pipe sizes shall be as recommended by unit manufacturer. Refer to piping schematic on drawings.

2.02 MATERIAL

- A. PIPE: Copper ACR tubing.
- B. FITTINGS: Wrought copper streamlined sweat fitting.
- C. SOLDER: Sil-Fos, except on valves use solder recommended by valve manufacturer.

2.03 ACCESSORIES

All accessories shall be UL listed and rated in accordance with ARI Standard 710.

- A. On systems 7-1/2 tons and larger, each separate refrigerant circuit shall have a separate filter dryer. Each filter dryer shall have a replaceable core and a three valve bypass. The filter drier shall be full line size and installed in the refrigerant liquid line. The filter shall have a minimum 4-3/4 inches diameter shell with removable flange and gasket. Flange shall be tapped for 1/4 inch FPT access valve. Size filter-drier for maximum 2.0 psi pressure drop at evaporator operating temperature. Similar to Mueller Brass Company model Drymaster micro-guard refillable filter series SD-485 through SD19217 or Sporlan

catch-all.

- B. On systems less than 7-1/2 tons, the filter dryer shall be the sealed type sizes as above. One drier per refrigerant circuit.
- C. Liquid-Moisture Indicator shall be installed in liquid refrigerant line full line size similar to Mueller Brass Company model "Vuemaster" with soldered ends.
- D. Thermostatic expansion valve shall have adjustable super heat and be as manufactured by Sporlan.

2.04 EVACUATION

Evacuate moisture completely by applying a commercial vacuum pump for a minimum of 24 hours. Moisture indicator shall indicate a completely moisture-free condition at time of final inspection. The vacuum pump shall run until the system indicates a maximum of 35 degrees FDB. The system shall be flushed with the operating refrigerant and the vacuum pump connected and rerun to repeat the evacuation. Evaluation shall be performed under supervision of the Engineer.

2.05 FREON AND OIL

- A. Contractor shall leave the refrigeration system with a full charge of freon and oil and shall be responsible for the maintenance of a full charge of freon and oil in the systems for a period of one year from date of acceptance.
- B. Should any leaks in the refrigeration system occur during the guarantee period, the Contractor shall eliminate such leaks and recharge system to a full charge of freon and oil at no cost to the Owner.

PART 3 - EXECUTION

- 3.01 All equipment and piping shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

- A. All pipe joints and pipe fittings shall be properly cleaned prior to brazing.
- B. An inert gas purge (e.g. nitrogen) shall be used during brazing to prevent oxides, which can contaminate system.

- 3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

END OF SECTION 23 53 00

SECTION 23 58 54 - "DX" FAN COIL UNIT

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 230500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

PART 2 - PRODUCTS

2.01 FAN COIL UNITS

Fan coil units shall be factory built, manufactured as scheduled on drawings. Carrier, York, Trane or McQuay shall be considered as equal, if they comply with the specification and schedule. Special Note: Contractor shall field verify exact clearances required for air handling units. Units shall be field located as required and shop drawings shall indicate final location for approval by Architect/Engineer.

- A. Furnish and install fan coil units of the type, capacities, ratings and drive motor horsepower shown on the drawings.
- B. Units shall be factory fabricated, draw-thru type, and shall have fan section, cooling coil section, condensate drain pan, adjustable blower drive with motor on resilient mounted base, vee-belts with guard, filter section, and mixing box (if scheduled) assembled as integrated air handling units.
- C. REQUIREMENTS:
 - 1. Mill-galvanized steel, rigidly framed, braced, and reinforced; access panels each side of unit; minimum panel ga. - 18; minimum weight formed framing member 14 ga.
 - 2. Fan section, cooling coil section, and outlet frame throats shall be internally insulated at the factory with 1" thick, 3/4 PCF density, Neoprene coated fiberglass cemented in place with water-proof adhesive, having fire-retardant characteristics in accordance with NFPA 90A.
 - 3. Drain pan shall be not lighter than 14 ga.; extend completely under the coil section and be all-galvanized, foam insulated pan with drain connections.
 - 4. When the fan coil unit is installed above an accessible ceiling, the unit shall

incorporate a secondary drain pan. The secondary pan shall be fabricated from galvanized sheet metal, 16 gauge minimum with cross breaking sloped towards a drain. The sides shall be a minimum 2" tall and the corners shall be soldered watertight. The top edge shall have a 1/4" hem to provide additional rigidity and the secondary pan shall be supported at a minimum of six points. The pan shall extend on all sides a minimum of 3" beyond the sides of the unit casing. Route the secondary drain piping to a conspicuous location or install a float switch at the low point in the secondary pan. The secondary pan should be sloped a minimum of 1/8" per foot and supported so that the unit is not in contact with the bottom of the secondary pan.

5. The fan section, including wheels, shafts, bearings, drive, etc., shall be statically and dynamically balanced as an assembly, and the shaft shall not pass through the first critical speed, while accelerating from rest to operating speed. Submittal data shall state the first critical shaft speed. Shaft bearings shall be of vacuum de-gassed steel, and shall be selected for 200,000 hours average life.
6. Coil shall be as hereinafter specified.

2.02 COILS

- A. Cooling coils shall be cartridge type and, when mounted in air handling units, shall be removable from either end. Coils shall be constructed of copper tubes with aluminum fins and shall be designed for even distribution of air across the face of the coils; air shall not pass around coil frames: Coils shall have same end connection for DX or chilled water piping.
- B. DX refrigerant coils shall be counter-flow refrigerant to air, shall have inlet and outlet connections permanently marked shall have thermostatic expansion valves with adjustable super heat.
- C. Maximum face velocity across cooling coils shall be 500 FPM, unless noted otherwise on schedule.

PART 3 - EXECUTION

- 3.01 All HVAC equipment shall be installed as per manufacturers printed installation instructions.
- 3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

END OF SECTION 23 58 54

SECTION 23 67 10 - AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 230500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

PART 2 - PRODUCTS

2.01 AIR-COOLED CONDENSING UNITS

- A. Air-cooled condensing unit shall be designed for use with split system having a remote direct-expansion (DX) cooling coil mounted in evaporator fan unit. Capacity shall be as called for on the drawings when matched to the appropriate evaporator coil.
- B. Condensing unit shall consist of high-efficiency hermetic compressor, air-cooled condenser with quiet fan, factory wired controls, R-454B refrigerant and refrigeration circuit and valves.
- C. Cabinet shall be heavy-gauge galvanized steel with bonding primer and baked-enamel finish coat. The entire cabinet shall be protected from rust.
- D. Condenser coils and entire cabinet shall be factory coated with a 10,000 hour salt spray coating equivalent to Energy Guard's E-Guard DCC Cabinet Casing and DCC Green. Coatings shall meet ASTM B-117, ASTM G85, and ASTM D4587/4141 for UV Weathering.
- E. Compressor shall be protected from excessive current and temperatures and shall be provided with a thermostatically controlled crankcase heater to operate only when needed for protection of the compressor. Compressor shall be spring-mounted on rubber isolators. Compressor shall be located in compartment isolated from condenser fan and coil. Provide a high-capacity dryer in the system to remove moisture and dirt.
- F. Condenser fan shall be directly connected to a weather-protected, quiet, high-efficiency motor. Fan guard shall be provided and shall be protected from rust by PVC finish. Condenser coil shall be aluminum fin with copper tube.

- G. Connections for refrigerant suction and liquid lines shall be extended outside the cabinet and provided with service valves with gauge connections.
- H. Power connections shall be made to the connectors located inside the electrical connection box.
- I. Standard operating and safety controls shall include high-pressure switch, low pressure switch, compressor overload service, and solid-state timed-off control.
- J. All components (parts and labor) of the sealed refrigeration circuit shall be warranted by the manufacturer for five years.

2.02 AUXILIARY EQUIPMENT

- A. Auxiliary equipment shall consist of refrigerant lines prepared for the unit involved. These lines shall be cleaned, dried, and pressurized at the factory.
- B. Low ambient kit to allow operation at outside temperature below 35 deg. F (2 deg. C) shall be provided.
- C. Expansion valve shall be provided with the evaporator coil.
- D. Provide thermostat to match the requirements of the job. Thermostat shall provide subbase with Heat-Cool-Off and Fan On-Auto switch. See section on controls for other related requirements.
- E. Provide polyethylene structural base designed for that service and intended to support the unit and eliminate vibration transmission.
- F. Provide hard-start kit with unit.
- G. Provide guards for condenser coils.

2.03 ACCEPTABLE MANUFACTURERS

- A. Condensing unit shall be the make and model number shown on the drawings or acceptable equivalents by Lennox, Carrier, York, or Trane.

PART 3 - EXECUTION

3.01 All HVAC equipment shall be installed as per manufacturers printed installation instructions.

3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

3.03 INSTALLATION

- A. Install the condensing unit on proper foundation as shown on the drawings, and in location that will not restrict the air entry or discharge from the unit.
- B. Install refrigerant lines as recommended by the manufacturer, taking care not to lose the refrigerant charge contained in the lines, or allow air to enter the lines or equipment. Locate the lines in such a way as to not obstruct access to the condensing unit or other equipment. Lines located under ground or under concrete shall be installed in a PVC pipe conduit for protection.
- C. Provide electrical connections as required by the applicable codes. Provide control wiring required. All power wiring and control wiring shall be in conduit and located so as not to obstruct access to the unit or other equipment.

3.04 TESTING

- A. Operate the condensing unit and the system to assure that unit is operating properly and without excessive noise and vibration.
- B. Read and record the power draw and the refrigeration suction and liquid pressures as required by Balancing and Test, Section 239900.

END OF SECTION 23 67 10

SECTION 23 86 00 - POWER VENTILATORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Ceiling and inline ventilators.

1.02 RELATED SECTIONS

- A. Section 230500 – Basic Materials and Methods
- B. Section 231700 – Motors and Motor Controllers
- C. Section 232400 – Sound and Vibration Control
- D. Section 239510 – Controls
- E. Section 239900 – Testing, Adjusting and Balancing

1.03 QUALITY ASSURANCE

- A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."
- B. UL Compliance: Fans and components shall be UL listed and labeled.
- C. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- F. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- G. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.04 SUBMITTALS

1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
2. Product data for selected models, including specialties, accessories, and the following:
 - a. Certified fan performance curves with system operating conditions indicated.
 - b. Certified fan sound power ratings.
 - c. Motor ratings and electrical characteristics plus motor and fan accessories.
 - d. Materials gages and finishes, include color charts.
 - e. Dampers, including housings, linkages, and operators.
 - f. Full color paint samples.
3. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
4. Coordination drawings, in accordance with Division 23 Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
 - a. Roof framing and support members relative to duct penetrations.
 - b. Ceiling suspension members.
 - c. Method of attaching hangers to building structure.
 - d. Size and location of initial access modules for acoustical tile.
 - e. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
6. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
7. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.
8. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "Basic Materials and Methods".

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be stored and handled in accordance with the unit manufacturer's instructions.
- B. Lift and support units with the manufacturer's designated lifting or supporting points.
- C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ACME, Inc.
- B. Loren Cook Company
- C. Greenheck Fan Corporation
- D. Substitutions under provisions of Division 1.

2.02 GENERAL DESCRIPTION

- A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.
- B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
- C. Provide factory baked-enamel finish coat after assembly. Color shall be verified during the submittal process.

2.03 CEILING AND INLINE VENTILATORS

- A. Ceiling and inline ventilators shall be direct drive or belt drive as indicated, centrifugal blower type. Fan wheel shall be constructed of galvanized steel and shall be dynamically balanced. The housing shall be constructed of minimum 20 gauge corrosion resistant galvanized steel and acoustically insulated for quiet operation. Blower and motor assembly shall be easily removable from the housing without disturbing the ductwork. The motor shall be permanently lubricated with built-in thermal overload protection and shall be factory tested prior to shipment. The ceiling ventilators shall be furnished standard with a powder-painted white steel grille.
- B. Ventilators shall be certified and licensed to bear the AMCA Seal for Air and Sound Performance. Ventilator performance shall be based on tests and procedures performed in accordance with AMCA publication 211 and comply with the requirements of the AMCA Certified Ratings Program. Fan sound power level ratings shall be based on tests and procedures performed in accordance with AMCA publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Ventilators shall be UL listed and CSA certified.
- C. Accessories: The following accessories are required.
 - 1. Dampers:

- a. Aluminum backdraft damper.
 - b. U.L. listed ceiling radiation damper for ceiling fans comply with NFPA Standard 90A rated for 3 hours.
2. Disconnect Switch: Fans less than one horsepower, provide nonfusible type with thermal overload protection. Fans greater than one horsepower, disconnect shall be provided by Division 26.
3. Speed Controls: Fan mounted, solid state speed controller.

PART 3 – EXECUTION

3.01 Install in accordance with manufacturer's instructions.

3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

END OF SECTION 23 86 00

SECTION 23 88 10 - AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Ceiling air diffusers.
- B. Wall registers and grilles.
- C. Louvers.
- D. Other air devices indicated on drawings and schedules.

1.02 RELATED SECTIONS

- A. Section 230500 – Basic Materials and Methods
- B. Section 238900 – Metal Ductwork
- C. Section 239100 – Ductwork Accessories
- D. Section 239900 – Testing, Adjusting and Balancing

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air distribution devices of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air distribution devices in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air distribution devices in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 5. NFPA Compliance: Install air distribution devices in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air distribution devices including the following:
 - 1. Schedule of air distribution devices indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air distribution devices, and accessory furnished; indicating construction, finish, and mounting details.
 - 3. Performance data for each type of air distribution devices furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air distribution devices, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air distribution devices in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

1.06 WARRANTY

- A. Warrant the installation of the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or nonconforming workmanship.

PART 2 – PRODUCTS

2.01 DIFFUSER ACCEPTABLE MANUFACTURERS

- A. Titus Company
- B. Price
- C. Nailor Industries
- D. Krueger
- E. Substitutions under provisions of Division 1.

2.02 GENERAL DESCRIPTION

- A. Unless otherwise indicated, provide manufacturer's standard air devices when shown of size, shape, capacity, type and accessories indicated on drawings and schedules, constructed of materials and components as indicated and as required for complete installation and proper air distribution.
- B. Provide air devices that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- C. Unless noted otherwise on drawings, the finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM-870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50 inch pound force applied.
- D. Provide air device with border styles that are compatible with adjacent ceiling or wall system, and that are specially manufactured to fit into the wall construction or ceiling module with accurate fit and adequate support. Refer to architectural construction drawings and specifications for types of wall construction and ceiling systems.
- E. Provide integral volume damper with roll formed steel blades where indicated on drawings or schedules. Dampers shall be opposed blade design with a screw driver slot or a concealed lever operator for adjustment through the face of the air device.
- F. Air devices designated for fire rated systems shall be pre-assembled with UL classified radiation damper and thermal blanket. Fire rated air devices shall be shipped completely assembled; one assembly per carton. Each assembly shall be enclosed in plastic shrink wrap with installation instructions.

2.03 LOUVERS

- A. Except as otherwise indicated, provide manufacturer's rain resistant Hurricane rated louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.
- C. Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to architectural construction drawings and specifications for types of substrate.
- D. Louvers shall be constructed of aluminum extrusions, ASTM B 221, Alloy 6063-T5. Weld units or use stainless steel fasteners.

- E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.
- F. Acceptable Manufacturers:
 - 1. Ruskin Manufacturing Company
 - 2. Greenheck Company
 - 3. Louvers and Dampers, Inc.
 - 4. Substitutions under provisions of Division 1.

PART 3 – EXECUTION

- 3.01 All interior surfaces of all air devices shall be painted flat black.
- 3.02 See floor plans for type, neck size and CFM of air for all air distribution devices.
- 3.03 Install all air distribution devices as detailed on plans and in accordance with manufacturer's recommendations.

END OF SECTION 23 88 10

SECTION 23 88 85 - AIR FILTERS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 230500, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

PART 2 - PRODUCTS

2.01 FILTERS

- A. The filters shall be AAF Flanders Mini-Pleat Filters or approved equal.
- B. APPROVED MANUFACTURERS: The following manufacturers are approved subject to specification compliance.
 - 1. AAF Flanders
 - 2. American Air Filter.
 - 3. Airguard Industries, Inc.
 - 4. Cambridge.

2.02 LOW VELOCITY FILTER SECTION - MERV 8 FILTERS

- A. Filters shall be of the throwaway cartridge type in 24 inches X 24 inches with 2 inch frames. When installing multiple filters into slide-in frames tape adjacent filters together with duct tape to prevent bypassing of air around the filter. Media shall be rated at 500 feet per minute.
- B. Filtering media shall be formed of non-woven reinforced cotton fabric type filtering media bonded to 96% open area media support grid folded into a non-creased radial pleat design. The filter pack shall be bonded to the inclosing frame to prevent air bypass. Average efficiency shall be 25-30% on ASHRAE test standard 52.2. Initial resistance shall not exceed 0.20 inches water gauge at 350 FPM face velocity.

2.03 LOW VELOCITY RIGID BOX FILTER SECTION - MERV 13 FILTERS

- A. Filters shall be of the throwaway cartridge type in 24 inches X 24 inches with 4 inch frames. When installing multiple filters into slide-in frames tape adjacent filters together with duct tape to prevent bypassing of air around the filter. Media shall be rated at 500 feet per minute.
- B. Filtering media shall be formed of microglass paper with a water repellent binder type filtering media bonded to an open area media support grid folded into a non-creased radial pleat design. The filter pack shall be bonded to the inclosing frame to prevent air bypass. Average efficiency shall be 85% at 0.5 microns on ASHRAE test standard 52.2. Initial resistance shall not exceed 0.15 inches water gauge at 500 FPM face velocity.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install and relocate filters in the mechanical or the storage room in accordance with manufacturer's recommendations.
- B. Refer to Section 230500 for additional filter information.

END OF SECTION 23 88 85

SECTION 23 89 00 - METAL DUCTWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Low pressure ductwork.
- B. Medium and high pressure ductwork.
- C. Casings.

1.02 RELATED SECTIONS

- A. Section 230500 - Basic Material and Methods.
- B. Section 231400 - Supports and Anchors.
- C. Section 232900 - Duct Insulation.
- D. Section 239100 - Ductwork Accessories.
- E. Section 238810 - Air Distribution Devices.
- F. Section 239900 - Testing, Adjusting and Balancing.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms with least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. Codes and Standards:
 - 1. SMACNA Standards: Comply with latest SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
 - 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems", NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems", and NFPA 96 Standard.

4. IECC 2015: Comply with the 2015 International Energy Conservation Code.

1.04 GENERAL DESCRIPTION

- A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.05 SUBMITTALS

- A. Submit shop drawings, duct fabrication standards and product data under provisions of Division 1.
- B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work.
- C. The contract documents are schematic in nature and are to be used only for design intent. The contractor shall prepare sheet metal shop drawings, fully detailed and drawn to scale, indicating all structural conditions, all plumbing pipe and light fixture coordination, and all offsets and transitions as required to permit the duct to fit in the space allocated and built. All duct revisions required as a result of the contractor not preparing fully detailed shop drawings will be performed at no additional cost.

1.06 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain indicated clear size inside lining. Where offsets or transitions are required, the duct shall be the equivalent size based on constant friction rate.
- B. Low Pressure: Three pressure classifications: ½ inch WG positive or negative static pressure and velocities less than 1,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 1,500 fpm, and 2 inch WG positive or negative static pressure and velocities less than 2,000 fpm. Low pressure ductwork shall be defined as all return, exhaust, and outside air ducts associated with constant volume air handling units with a scheduled external static pressure of less than 1.5", and all supply ductwork downstream of terminal units in variable volume systems.
- C. Medium Pressure: Three pressure classifications: 3 inch WG positive or negative static pressure and velocities greater than 2,000 fpm but less than 3,000 fpm, 4 inch WG positive static pressure and velocities greater than 3,000 fpm but less than 4,000 fpm, and 6 inch WG positive static pressure and velocities greater than 4,000 fpm. Medium pressure ductwork shall be defined as all supply ducts extending from variable volume air handling units to terminal units in variable volume systems with air handling units having a scheduled external static pressure of less than 4". The supply ductwork of constant volume air handling units having scheduled external static pressure greater than 2" and less than 4" shall be rated for medium pressure.
- D. High Pressure: 10 inch WG positive static pressure and velocities greater than 6,000 fpm.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings, use sheet metal end caps on any lined duct exposed to the weather and use 3 mil vinyl wrap with duct tape on end pieces where stored inside.
- B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS

- A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.
- B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.
- C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A167; Type 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.
- D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14.

2.02 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Non combustible and conforming to UL 181, Class 1 air duct materials.
- B. Flexible Ducts: Flexmaster U.S.A., Inc. Type 1M or approved equal, corrosive resistant galvanized steel formed and mechanically locked to inner fabric with factory wrapped insulation blanket with aluminum vapor barrier and an R-6 thermal conductance. Flexible duct shall have reinforced metalized outer jacket comply with UL 181, Class 1 air duct. Equivalent manufactures are Thermaflex.
- C. Sealants: Hard-Cast "iron grip" or approved equal, non-hardening, water resistant, fire resistive and shall not be a solvent curing product. Sealants shall be compatible with mating materials, liquid used alone or with tape or heavy mastic.
- D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials.

2.03 LOW PRESSURE DUCTWORK

- A. Fabricate and support in accordance with latest SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings. Obtain engineer's approval prior to using round duct in lieu of rectangular duct.
 1. Exposed round ductwork shall have flanged connections. Slip connections are not allowed.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of airflow.
- F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded when concealed. Where joints are exposed to public view, only gasketed flanged fittings shall be used. Prime coat all welded joints.
- G. Use double nuts and lock washers on threaded rod supports.

2.04 MEDIUM AND HIGH PRESSURE DUCTS

- A. Fabricate and support in accordance with SMACNA High Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

- C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
- D. Fabricate continuously welded medium and high pressure round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.05 CASINGS

- A. Fabricate casings in accordance with SMACNA Low Pressure Duct Construction Standards and SMACNA High Pressure Duct Construction Standards and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Reinforce doorframes with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 6 X 6 inch size.
- D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb./cubic foot minimum glass fiber media, on inverted channels of 16 gage.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Obtain manufacturer's inspection and acceptance of fabrication and installation of ductwork at beginning of installation.
- B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

- D. Connect terminal units to medium or high pressure ducts with four feet maximum length of flexible duct. Do not use flexible duct to change direction.
- E. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with strap or clamp.
- F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- G. The interior surface of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.
- H. All ductwork located exposed on roof shall be "crowned" to prevent water from ponding. Ref: Insulation for additional requirements.
- I. Where ducts pass through floors, provide structural angles for duct support. Where ducts pass through walls in exposed areas, install suitable sheet metal escutcheons as closers.
- J. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.
- K. All ductwork shall be fabricated in a manner to prevent the seams or joints being cut for the installation of grilles, registers, or ceiling outlets.

3.02 INSTALLATION OF FLEXIBLE DUCTS

- A. Determine the minimum length of flexible duct needed for each connection. Excess flex causing tight bends and increased pressure drops are not acceptable. Do not exceed 6'-0" extended length.
- B. Install in accordance with Section III of SMACNA's, "HVAC Construction Standards, Metal and Flexible".
- C. Cut outer vapor barrier and insulation. Fold back insulation and outer vapor barrier to expose inner core. Using sheet metal snips, cut the inner core.
- D. Connect the inner core to the tap or collar by pulling it a minimum of 1" over the collar.
- E. Where collars are less than 1" in length, i.e. diffusers, connect a separate collar to the existing collar and proceed as described in 3.02.C above.
- F. Wrap the core twice with UL181 Tape over the collar. Secure the connection by placing a clamp over the tap or collar, UL listed Panduit clamps for collars with beads and Stainless Steel clamps for collars without beads are acceptable.
- G. Roll the insulation and vapor barrier back over the collar or tap as described in 3.02.C above and wrap twice with UL181 Tape.
- H. Secure the outer vapor barrier with a clamp as described in 3.02.F above if desired.

- I. For Medium to High Pressure applications, use duct sealer for 3.02.F and 3.02.G in lieu of UL181 Tape.
- J. Flexible duct shall be hung with proper support to minimize sagging and snaking between supports. Maximum of 4'-0" between supports. Hanger material will be a minimum of 1 1/2" wide.
- K. Supports will be used before all vertical 90° bends to prevent sagging and ensure a 1.5 center line turn radius of flexible duct.

3.03 REQUIREMENTS FOR UNIT CASINGS

- A. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

3.04 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Steel
Return and Relief	Steel, Aluminum
General Exhaust	Steel, Aluminum
Outside Air Intake	Steel
Residential Dryer Duct	Aluminum
Commercial Dryer Duct	Stainless Steel

3.05 DUCTWORK HANGERS AND SUPPORTS

- A. All ductwork shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the ductwork, provide a minimum of two screws one at the bottom and one in the side of each strap on metal ductwork. The spacing, size and installation of hangers shall be in accordance with the recommendations of the latest SMACNA edition.
- B. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Structural steel supports for duct risers shall be provided under this Division.

3.06 DUCT JOINTS AND SEAMS

- A. Seal all non-welded duct joints and seams with duct sealant as indicated. All longitudinal and transverse joints, seams and connections in metallic and non-metallic ducts shall be

constructed as per specified in SMACNA HVAC Duct Construction Standards-Metal and Flexible. All longitudinal and transverse joints, seams and connections shall be sealed in accordance with the latest adopted International Energy Conservation Code edition.

END OF SECTION 23 89 00

SECTION 23 91 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Volume control dampers.
- B. Round Duct Taps.
- C. Fire dampers.
- D. Combination fire and smoke dampers.
- E. Back draft dampers.
- F. Air turning devices.
- G. Flexible duct connections.
- H. Duct access doors.
- I. Duct test holes.

1.02 RELATED WORK

- A. Section 232400 – Sound & Vibration Control.
- B. Section 238900 – Metal Ductwork.

1.03 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA - Low Pressure Duct Construction Standards.
- C. UL 33 - Heat Responsive Links for Fire-Protection Service.
- D. UL 555 - Fire Dampers and Ceiling Dampers.

1.04 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors duct test holes. Provide product data for hardware

used.

- C. Submit manufacturer's installation instructions under provisions of Section 01300, for fire dampers and combination fire and smoke dampers.

PART 2 - PRODUCTS

2.01 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/2 inch diameter rod in self aligning, universal joint, action flanged bushing, with set screw.
- D. Fabricate single blade dampers for duct sizes to 9-1/2 x 24 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch.
 - 1. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 2. On outside air, return air, and all other dampers required to be low leakage type, provide galvanized blades and frames, seven inches wide maximum, with replaceable vinyl, EPDM, silicone rubber seals on blade edges and stainless steel side seals. Provide blades in a double sheet corrugated type construction for extra strength. Provide hat channel shape frames for strength and blade linkage enclosure to keep linkage out of the air stream. Construction leakage not to exceed 1/2%, based on 2,000 fpm and 4 inch static pressure.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.02 ROUND DUCT TAPS

- A. Taps to trunk duct for round flexible duct shall be spin-in fitting with locking quadrant butterfly damper, model no. FLD-B03 by Flexmaster or approved equal.

2.03 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS AND COMBINATION FIRE AND SMOKE DAMPERS

- A. Greenheck
- B. Louvers and Dampers Inc.
- C. Ruskin.
- D. Nailor Industries.

2.04 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Provide curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream.
- C. Fabricate multiple blade fire dampers per U.L. with 16 gauge minimum galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- D. Fusible links, UL 33, shall separate at 160 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

2.05 COMBINATION FIRE AND SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A, UL555 and UL 555S, and as indicated.
- B. Provide factory sleeve for each damper. Install damper operator on exterior of sleeve and link to damper operating shaft.
- C. Fabricate with multiple blades with 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
 - 1. Operators shall be spring return electric type suitable to operate on 120 V AC, 60 cycle.
 - 2. Operators shall be UL listed and labeled.
- D. See smoke dampers for details and accessories to be included

2.06 SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

- B. Motorized Smoke Dampers: normally open with power on, close automatically when power is interrupted, UL-listed and labeled damper and damper operator. Unit shall close upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices ensure positive closure for units mounted horizontally.
- C. Electro thermal Link: Fusible link which melts when subject to local heat of 165 degrees F and from external electrical impulse; UL listed and labeled.
- D. Each smoke damper and combination fire/smoke damper shall be equipped with end position indicators for remote indication of damper blade position.
- E. Furnish each smoke damper with a duct mounted smoke detector and sensing tube for proper operation of smoke damper. Duct smoke detectors shall be of the photoelectronic type. Sensing tube shall run the entire width of the duct and comply with manufactures instructions. Smoke detector and sensing tube shall be furnished and factory installed by the damper manufacture.

2.07 ACCEPTABLE MANUFACTURERS - BACKDRAFT DAMPERS

- A. Greenheck
- B. American Warming and Vent.
- C. Louvers and Dampers Inc.
- D. Ruskin.
- E. Substitutions: Under provisions of Division 1.

2.08 BACKDRAFT DAMPERS.

- A. Gravity back draft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16 gauge galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.09 ACCEPTABLE MANUFACTURERS - AIR TURNING DEVICES

- A. Young Regulator.
- B. Titus.

- C. Tuttle and Bailey.
- D. Substitutions: Under provisions of Division 1.

2.10 AIR TURNING DEVICES

- A. On duct sizes less than 12 x 12, multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.
- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with 18 inch long removable key operator.

2.11 ACCEPTABLE MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

- A. Metaledge.
- B. Ventglass.
- C. Substitutions: Under provisions of Division 1.

2.12 FLEXIBLE DUCT CONNECTIONS TO AIR MOVING EQUIPMENT

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.

2.13 ACCEPTABLE MANUFACTURERS - DUCT ACCESS DOORS

- A. Greenheck
- B. Ruskin.
- C. Titus.
- D. Substitutions: Under provisions of Division 1.

2.14 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover. Insulation shall be replaceable without field cutting or patching.
- D. Access doors smaller than 12 inches square may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- F. Access doors with sheet metal screw fasteners are not acceptable.

2.15 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Balancing Dampers
 - 1. Provide at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers only where indicated.
 - 2. All regulators mounted on externally insulated ductwork shall have 16 gauge elevated platforms at least 1/8 inch higher than the thickness of the insulation. Damper shaft shall have Ventlock No. 607 bearing mounted on ductwork within elevated platform. If duct is inaccessible the operating handle shall be extended and the regulator installed on the face of the wall or ceiling. Where regulators are exposed in finished parts of the building, they shall be flush type, Ventlock No. 666. All regulators shall be manufactured by Ventlock, or approved equal.
 - 3. All dampers in lined ductwork shall have bushing to prevent damper damage to liner.
 - 4. Provide cable extensions with adjustable regulators and cover plate for dampers located in locations not accessible such as behind sheetrock ceilings. Regulators shall be equivalent to Young's Regulator.
- C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire

rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

- D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- E. Provide back draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- F. Provide flexible duct connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Provide at least one inch slack at all flexible duct connections.
- G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.
- H. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 23 91 00

SECTION 23 99 00 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Conditions of the contract and general requirements in Division 1 apply to work specified in all section of Division 23.
- B. All Division 23 specification sections, drawings, and general provisions of the contract apply to work of this section, as do other documents referred to this section.
- C. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- D. Requirements for submittals, shop drawings, and substitutions, Division 1, Section 013000 and 016000, apply to work specified in all sections of Division 23.
- E. The basic Materials and Methods, Section 230500, are included as a part of this Section as though written in full in this document.

1.02 REFERENCES AND STANDARDS

- A. The publications listed below from a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATED AIR BALANCE CONCIL (AABC)

(2002) National Standards for Testing Adjusting Balancing of Environmental Systems

NATIONAL EVROMENTAL BALANCING BUREAU (NEBB)

(1998) National Standards for Testing Adjusting Balancing of Environmental Systems

(1994) Procedural Standards for the Measurement and Assessment of Sound and Vibration

- B. TAB shall be preformed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC or NEBB procedural standards, unless otherwise specifies herein. All recommendations and suggested practices contained in the TAB standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc. Shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB standard shall be used for all aspects of TAB, including qualifications, for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more

stringent than those listed in the TAB Standard, the manufacture's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB standard TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc. applicable to the Contact requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

- C. The TAB contractor shall submit all questions regarding interpretations and questions regarding these standards in writing or as required by documents to the A/E team who shall provide formal reply in ka reasonable time. Decisions of the A/E team shall be final.

1.03 DEFINITIONS AND SIMILAR TERMS

- A. In some instances, terminology differs between the Contract TAB Standard primarily because the intent of this section is to use the industry standards specified, along with the additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent the corresponding AABC or NEBB where differences.

<u>CONTRACT TERM</u>	<u>AABC TERM</u>	<u>NEBB TERM</u>
TAB Standard	National Standard Testing and Balancing Heating, Ventilating, and Air Conditioning System	Procedural Standards for Testing Adjusting Environmental System
TAB Specialist	TAB Engineer	TAB Supervisor
System Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures

1.04 QUALIFICATIONS

- A. The TAB of the air conditioning systems will be performed by an independent, impartial technical firm whose operations are limited only to the field of professional TAB, and is not a part or subsidiary of any other project contractor or subcontractor, to include, but not limited to General Contractor, and Mechanical; Contractor. The TAB work will be done under the direct supervision of qualified Professional Engineer employed as a full time employee of TAB firm.
- B. The TAB agency shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications.
- C. QUALIFICATIONS OF CONTRACTOR PERSONAL: Submit evidence to show that the people who shall be in charge of correcting deficiencies for balancing the systems are qualified. The Owner and Engineer reserve the right to require that the originally approved

personal be replaced with other qualified personnel if, in the Owner and Engineer's opinion, the original personnel are not qualified to properly place the system in condition for balancing.

D. QUALIFICATIONS OF TAB FIRM

The certification shall be maintained for the entire duration of specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately execute each certifying agency's applicable Performance Guaranty, then immediately notify the Contracting Officer and submit another TAB firm for approval, at no additional cost to Project Owner, Architect, Engineer, or their designated representatives. Any firm that has been the subject to disciplinary action by either the AABC or the NEBB within the five years preceding the contract award shall not be eligible to perform any duties related to the HVAC systems including TAB. All work specified in this section and in other related sections to be performed by the TAB firm shall be considered invalid if the TAB firm loses its certification prior to contract completion and must be performed by an approved successor, at no additional cost to Project Owner, Architect, Engineer, or their designated representative. The TAB firm shall have an occupied office within 100 miles of the project site.

E. QUALIFICATIONS OF TAB FIRM PERSONAL:

1. A minimum of one registered Professional Engineer, licensed in the State the work is performed, is required to be in permanent employment of the firm.
2. The TAB Specialist shall be either a member of AABC or an experienced technician of the firm certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason the Specialist loses subject certification during this period, the Contractor shall immediately execute each certifying agency's applicable Performance Guaranty, then immediately notify the Contracting Officer and submit another TAB Specialist for approval, at no additional cost to Project Owner, Architect, Engineer, or their designated representatives. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding the contract award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this section and other related sections to be performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses certification prior to the contract completion and must be performed by an approved successor, at no additional cost to the Project Owner, Architect, Engineer, or their designated representatives.
3. Personal used on the job site shall be either Professional Engineers or technicians, who shall have been permanent, full time employees of the firm for a minimum of six months prior to the start of work for that specified project.
4. Evidence shall be submitted to show that the personal who actually balanced the systems are qualified. Evidence showing that the personnel have passed the tests required by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) shall be required.

F. ACCEPTABLE TAB FIRMS SHALL INCLUDE:

1. PHI Service Agency (361-248-4861)
2. Engineering Air Balance Company (210-736-9494)
3. Testing Specialties (210-492-8885)
4. TCx Synergy (361-960-3475)

1.05 SCOPE OF WORK

- A. The Contractor will contract with a professional TAB firm under the provisions of paragraph 1.04 of this section.
- B. The TAB firm will be responsible for inspecting, adjusting, balancing, and logging the data on the performance of fans, dampers in the duct system, and air distribution devices. The Contractor and the various subcontractors of the equipment installed shall cooperate with the TAB firm to furnish necessary data on the design and proper applications of the system components and provide labor and material required to eliminate deficiencies or poor performance.
- D. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting, and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking specified measurements, recording and reporting the results. The items requiring testing, adjusting, and balancing include the following (as applicable to contract drawings):

AIR SYSTEMS

Air Handling Units
Exhaust Fans
Diffusers, Registers, & Grilles
Coils (Air Temperature)

DX Refrigerant Systems

Refrigerant Pressures Suction/Liquid
Refrigerant Temperature Measurements
(Sat Suction, Suction Line, SuperHeat, Liquid Sat, Liquid Line
Subcooling Temp, and Discharge Line Temp)

PLUMBING SYSTEMS

Recirc Pumps

1.06 SUBMITTALS AND RELATED DOCUMENTS:

- A. The name of the selected AABC or NEBB certified firm shall be submitted to the Engineer for approval within 30 days after contract award.

- B. Within 30 days after the award of contract, the TAB firm shall submit for approval an organizational chart and proof of current certification which shall identify all AABC or NEBB certified Supervisors or Specialist. The TAB firm shall submit a company resumes listing personal and project experience in air and hydronic system balancing. TAB firm will also provide information showing successful completion for three similar scope projects for which the firm is being contracted.
- C. Within 30 days after the award of contract, the TAB firm will submit for approval the name of the TAB Specialist and/or Professional Engineer, who will have direct supervision of all TAB related labor through completion of project.
- D. Within 30 days after the award of contract the TAB firm shall submit TAB procedures and agenda proposed to be used.
- E. Within 30 days after the award of contract, but prior to TAB field measurements, the TAB firm shall submit sample report forms, sample report forms, which shall include minimum data required by either the AABC or NEBB National Standards.
- F. Within 15 days of notification of approval of TAB firm and TAB Specialist by engineer, TAB firm shall conduct a Design Review of contract drawings and submit a Design Review report.
- G. Proposed date and time for execution of Systems Readiness Inspection shall be submitted no later than 7 days prior to inspection. A copy of the Systems Readiness Inspection Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.
- H. Proposed date and time to begin field measurements, making adjusting, ext., for the TAB report, shall be submitted with the Systems Readiness Inspection Report.
- I. Six (6) copies of the completed TAB Report shall be submitted for approval no later than 7 days after the execution of TAB. All copies of TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.
- J. Proposed date and time to begin TAB Completion Verification, shall be submitted with the TAB Report. Six (6) copies of TAB Completion Verification Report shall be submitted no later than 7 days after execution of TAB verification.
- K. Proposed date and time for execution of Opposite Season Inspection shall be submitted no later than 7 days prior to inspection.

1.07 INSTRUMENTATION

- A. All instruments used for measurements shall be accurate and calibrated. TAB firm shall submit list of all instruments, to include gauges, thermometers, flow measuring hoods, and other balancing devices to be used in balancing the system. The list will indicate name of equipment, function, model number, serial number, date of the last calibration, and date calibration is due. TAB firm shall submit copies of calibration certificates for all test instruments used showing all devices were properly calibrated before proceeding with

system balancing. All instruments will be within one year of calibration for duration of the project. If duration of project exceeds the tenure of instrument calibration, then said instrument must be recalibrated, and copy of calibration certificate sent to Engineer, before the instrument is placed into continued use.

1.08 TAB PREPARATION AND COORDINATION

- A. It is the intent of this specification section to provide for a completely tested, adjusted, and balanced (TAB) installation without overlaps or omissions between the installing contractor and the TAB contractor. The installing contractors are those who perform the installation of this work and make all preparations for the TAB contractor who performs the testing, adjusting, and balancing described herein.
- B. The contractor Manager or General Contractor performing the General construction work shall coordinate the work of the contractors performing the Mechanical, Electrical, Automatic Temperature Control, and TAB work to provide complete properly tested, adjusted, and balanced systems. The Construction Manager or General Manager shall require and provide a start-up report for each piece of equipment furnished.
- C. The contractor performing the HVAC work shall coordinate all Mechanical work, including Sheet Metal work and Automatic Temperature Controls, to provide a complete, properly tested adjusted and balanced system throughout. He shall furnish progress reports regarding this phase of the work on a regular basis as directed. At such time as the systems are started up, the Contractor performing the Mechanical work shall provide TAB Contractor with documentation that the duct systems have been tested to the satisfaction of the Duct Leak Test Specifications. The Mechanical Contractor shall insure that all components are installed and operating, and the major components such as fans, pumps, refrigeration machines, and the like are capable of producing the scheduled capacity requirements. The requirement does not relieve the Mechanical Contractor of any other requirements specified elsewhere. Should any of these components or systems not be capable of producing these requirements, he shall make corrections within the limits of his responsibility or as otherwise authorized and shall certify in writing that the systems are ready for final testing and balancing by the Tab contractor.
- D. The contractor performing the Electrical work shall work coordinate all electrical work to provide complete, properly tested, adjusted and balanced mechanical systems throughout the project. He shall furnish progress reports on a regular basis as directed. He shall certify in writing when each system is electrically operable, including the check for proper rotation of equipment.
- E. The Contractor performing the Automatic Temperature Controls work shall coordinate all controls work to provide complete, properly tested, adjusted and balanced mechanical systems throughout the project. He shall furnish progress reports on a regular basis as directed. He shall certify in writing when each system is operational from an Automatic Temperature Controls standpoint. This contractor shall also provide to TAB contractor all necessary submittal information, software, and/or personal complete, properly tested, adjusted and balanced mechanical systems.
- F. The TAB contractor shall from the award of contract, begin preparation.

PART 2-PRODUCTS (NOT USED)

PART 3- EXECUTION

3.01 SERVICES OF THE CONTRACTOR

- A. The drawing and specifications have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, install these devices in a manner that leaves them accessible, provide access as requested by the TAB firm.
- B. Have systems complete and in operational readiness prior to notifying the TAB firm the project is ready for their services, and certify in writing to the Construction Manager that such a condition exists.
- C. As a part of the Work of this Section, make changes in the sheaves, belts, and dampers or the addition of dampers required for correct balance of new work as required by TAB firm, at no additional cost to owner.
- D. Fully examine the existing system to be balanced, to determine, whether or not sufficient volume dampers, balancing valves, thermometers, gauges, pressure in the duct systems, means of determining water flow, and other means of taking data needed for proper water and air balancing are existing. Submit to the Engineer in writing a listing of omitted items considered necessary to balance existing systems. Submit the list and proposal as a cost add item.
- E. Verify that fresh air louvers are free of blockage, coils are clean and fresh air ducts to each air handling unit has individually adjustable volume regulating dampers.
- F. Provide correct, repair, or replace deficient items or conditions found during the testing, adjusting, and balancing period.
- G. In order that systems may be properly tested, balanced, and adjusted as specified, operate the systems at no expense for the Owner at the length of time necessary to properly verify their completion and readiness for TAB period.
- H. Project Contract completion schedules shall allow time for allowance to permit the successful completion of TAB services to Owner's final inspection and expectance. Complete, operational readiness, prior to commencement of TAB services, shall include the following services of the Contractor:
 - 1. Construction status of building shall permit the closing of doors, window, ceilings, installed and penetrations complete, to obtain project operating conditions.
 - 2. AIR DISTRIBUTION SYSTEMS:
 - a. Verify installation for conformity to design. Supply, return, and exhaust ducts terminated and pressure tested for leakage as specified.
 - b. Volume and fire dampers properly located and functional. Dampers serving requirements of minimum and maximum outside air, return and

- relief shall provide tight closure and full opening, smooth and free operation.
 - c. Supply return, exhaust and transfer grilles, registers and diffusers.
 - d. Air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, ect., shall be blanked and sealed to eliminate excessive bypass or leakage of air.
 - e. Fans (supply and exhaust) operating and verified for freedom from vibrations, proper fan rotation and belt tension; overload heater elements shall be of proper size and rating ; record motor amperage and voltage and verify that these functions do not exceed nameplate ratings.
 - f. Furnish or revise fan drives or motors as necessary to attain the specified air volumes.
3. WATER CIRCULATING SYSTEMS
- a. Position valves pertinent to system design and require operation to permit full flow of water through system components. Operate systems under full flow conditions until circulating water is clean. Remove and clean strainers as required during this cycle of operation.
 - b. Record each pump motor amperage and voltage. Readings shall not exceed nameplate rating.
 - c. Verify, on new equipment, electrical starter overload heater elements to be of proper size and rating.
 - d. Ensure that water circulating systems shall be full of water and free of air; expansion tanks set for proper water level, and air vents installed at high points of systems and operating freely. Advise Owner of deficiencies.
 - e. Check and set operating temperatures of heat exchangers to design requirements.
4. AUTOMATIC CONTROLS
- a. Verify that control components are installed in accordance with project documents and functional, electrical interlocks, damper sequences, air and water resets, fire and freeze stats.
 - b. Controlling instruments shall be functional and set for design operating conditions. Factory pre-calibration of room thermostats and pneumatic equipment will not be acceptable.
 - c. The temperature shall be regulation shall be adjusted for proper relationship between the controlling instruments and calibrated by the TAB Contractor. Advise Owner of deficiencies or malfunctions.

3.02 SERVICES OF THE TAB FIRM

- A. The TAB firm will act as liaison between the Owner, Engineer, and Contractor and inspect the installation of mechanical piping system, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems being retrofitted, repaired, or added under this Contract. The re-inspection of the Work will cover that part related to proper arrangement and adequate provision for the testing and balancing and will be done when the Work is 80 percent complete.
- B. Upon completion of the installation and start –up of the mechanical equipment, to check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building. Prepare and submit to the Owner complete reports on the balance and operations of the systems.

- C. Measurements and recorded readings of air, water and electricity that appear in the TAB reports will be done by the permanently employed technicians or engineers of the TAB firm.
- D. Make an inspection in the building during the opposite season from that in which the initial adjustments were made. At the time, make necessary modifications to the initial adjustments required to produce optimum operation of system components to effect the proper conditions as indicated on the Drawings. At time of opposite season check-out, the Owner's representative will be notified before readings and adjustments are made.
- E. In fan systems, the air quantities indicated on the Drawings may be varied as required to secure a maximum temperature variation of two degrees with each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the Contractor to furnish or revise fan drive and motors if necessary, without cost to the Owner, to attain the specified air volumes.
- F. The various existing water circulating systems shall be cleaned, filled, purged, of air, and put into operation before hydronic balancing.

3.03 PROFESSIONAL REPORT

- A. Before the final acceptance of the report is made the TAB will furnish the Owner the following data to be approved by the Owner and Engineer.
 - 1. Summary of main supply, return and exhaust duct pilot tube traverses and fan settings indicating minimum value required to achieve specified air volumes.
 - 2. A listing of the measured air quantities at each outlet corresponding to the temperature tabulation as developed by the Engineer and TAB firm.
 - 3. Air quantities at each return and exhaust air handling device.
 - 4. Static pressure readings entering and leaving each supply fan exhaust fan, filter, coil, balancing dampers and other components of the systems included in the retrofit Work. These readings will be related to performance curves in terms of the CFM handled if available,
 - 5. Motor current readings at each equipment motor on load side of capacitors. The voltages at the time of the reading shall be listed.
 - 6. The final report shall certify test methods and instrumentation used, final velocity reading obtained, temperatures, pressure drops, RPM of equipment, amperage of motors, air balancing problems encountered, recommendations and uncompleted punch list items. The test results will be recorded on standard forms.
 - 7. A summary of actual operating conditions shall be included with each system outlining normal and ventilation cycles of operation. The final report will act as a reference of actual operating conditions for the Owner's operating personal.

3.03 BALANCING AIR CONDITIONING SYSTEM

A. GENERAL

- 1. Place all equipment into full operation, and shall continue the operating during each working day of balancing and testing. If the air conditioning system is balanced during

- OFF-Peak cooling seasons Balancing Contractor shall return to rebalance air side system as required to put system in proper balance at that time.
2. The contractor shall submit detailed balancing and recording forms for approval. After the approval by the Architect, prepare complete set of forms for recording test data on each system. All Work shall be done under the supervision of Registered Professional Engineer. All instruments used shall be accurately calibrated to within 1% of scale and maintained in good working order.
 3. Upon completion of the balancing and testing, the Balancing Contractor shall compile the test data in report forms, and forward five copies to the Architect for evaluation
 4. The final report shall contain logged results of all tests, including such data as
 - a. Tabulation of air volume at each outlet.
 - b. Outside dry bulb and wet bulb temperature.
 - c. Inside dry bulb and wet bulb temperature in each conditioned space room or area.
 - d. Actual fan capacities and static pressures. Motor current and voltage readings at each fan.
- B. AIR SYSTEMS: Perform the following operations as applicable to system balance and test:
1. Check fan rotation.
 2. Check filters (balancing shall be done with clean filters).
 3. Test and adjust blower rpm to design requirements.
 4. Test and record motor full load amperes.
 5. Test and record system static pressures, suction and discharge.
 6. Test and adjust system for design cfm, return air and outside air (+2%). Change out fan sheaves as required to balance system.
 7. Test and record entering air temperatures, db and wb.
 8. Test and record leaving air temperature, db and wb
 9. Adjust all zones to design cfm (+2%).
 10. Test and adjust each diffuser, grille, and register to within 5% of design.
- C. WATER SYSTEMS: Perform the following operations as applicable to system balance and test:
1. Check pump operation
 2. Check operation of all mixing valves.
 3. Test water flow rate at all pumps. Adjust balancing valves as required.
 4. Record water temperature entering and leaving the pump and water heater.
 5. Record pump suction and discharge pressures.
- D. DX SYSTEMS:
1. Test and record suction and discharge pressures at each compressor and record ambient air temperature entering the condensing coils.
 2. Test and record unit full load amps and voltage.
 3. Test and record staging and unloading of unit required by sequence of operation or drawing schedule.
- E. Automatic temperature controls shall be calibrated and all thermostats and dampers, adjusted so that the control system is in proper operating condition, subject to approval of the Architect.

- F. The Air Balance Contractor shall report to Engineer all air distribution devices or other equipment that operate noisily so that corrective measures may be implemented by the Contractor at no additional cost to the owner.

END OF SECTION 23 99 00

SECTION 26 01 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE:

- A. The Contractor shall execute all work as hereinafter specified, as shown on the drawings or as necessary to provide complete and functioning systems. All items of labor, material or equipment not required in detail by the specifications or drawings, but incidental to or necessary for the complete installation and proper operation of all phases of work described herein, or reasonably implied in connection therewith, shall be furnished as if called for in detail by the specifications or drawings.

1.02 LAWS AND ORDINANCES:

- A. All work and materials shall conform to the requirements of the federal, state, and local laws and ordinances having jurisdiction at the jobsite. The installation shall be in strict accordance with the latest edition of the National Electrical Code (NEC). The Contractor at no increase in contract price shall make all modifications to the work, which may be required by an authority having legal jurisdiction over the work.

1.03 LICENSES, FEES AND PERMITS:

- A. The Contractor shall have a Master Electrician license issued by or acceptable to the city in which the work is to be performed. Additionally, and at all times while work is being performed, for every five or less craftsman working on the project site, at least one craftsman shall have a Journeyman Electrician license issued by or acceptable to the city in which the work is to be performed.

1.04 THE DRAWINGS AND SPECIFICATIONS:

- A. The drawings and specifications shall be interpreted together, and any and all work included in either, though not in both, shall be part of the contracted work. The drawings are diagrammatic but shall be followed as closely as actual construction of the project and existing job site conditions will permit. Any changes due to equipment supplied, conflict with the work of other trades or to make this work conform to the National Electrical Code shall be made by the Contractor at no increase in contract price.

1.05 SITE CONDITIONS:

- A. Before submitting his bid, the Contractor shall visit the site and familiarize himself with all existing conditions and his bid shall be based on accepting conditions as they exist.

1.06 MATERIALS AND EQUIPMENT:

- A. All materials and equipment furnished by the Contractor shall be new. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such materials and equipment. Where two or more units of the same item are required, they shall be products of a single manufacturer. The Contractor shall unload and properly store all electrical materials and equipment delivered to the jobsite.

1.07 UTILITY CONNECTIONS AND SERVICE:

- A. The Contractor shall make arrangements for connection with the electrical utility company that will serve the jobsite and shall comply with all the rules, regulations and requirements of the utility company. The Contractor shall examine the site, confer with the utility company and verify the requirements for connections prior to bidding the work. The Contractor shall verify with the utility company the exact location of service tie-in points, cable routes, etc. Failure of the Contractor to contact the utility company and obtain such information prior to bidding the work shall not be considered as a basis for additional compensation. Where outages to existing electrical service are required, the Contractor shall coordinate the timing and duration of such outages with Owner's representative.
- B. The Contractor shall furnish and install a meter enclosure for the utility company meter. The enclosure and installation shall be in accordance with utility company requirements.

1.08 SAFETY:

- A. It shall be the responsibility of the electrical Contractor to initiate, maintain, and supervise all safety precautions required by local, state, and federal laws, including OSHA.

1.09 SUBMITTALS:

- A. Submittals for Approval:
 - 1. Submit in accordance with Section 013000 except as otherwise stated herein.
 - 2. Within 30 calendar days after award of contract, the Contractor shall furnish seven (7) sets of drawings and data as described herein for Engineer approval. No item of equipment or material shall be ordered or shipped to the job site until the Engineer has given written approval of the submittal data.
 - 3. The submittal data shall be bound in a 3-ring binder with dividers. The binder shall include a cover and a table of contents with the contractors name as well as the name of the project. All data shall be divided by specification section.
 - 4. The submittal data for each item shall include descriptive literature, performance data, shop drawings technical literature and any other necessary data to readily identify that the equipment will meet the requirements of the drawings and specifications.
 - 5. One complete submittal of drawings and data shall be made for all required items. Partial or incomplete submittals will be returned without comment. All copies furnished shall be manufacturer's original copies of good quality, legible photocopies or blue line prints. Copies transmitted by facsimile machine are not acceptable.
 - 6. Submittal documents shall be job specific. Where manufacturer's standard drawings or catalog sheets are provided, they shall be marked to show specifically what is being furnished. Drawings shall be marked to show Owner's name, plant location, project description and equipment designation.
 - 7. Substitutions for specified products shall be in compliance with Paragraph 1.10.

8. The Contractor shall review all manufacturers' submittals for completeness, accuracy and compliance with project specifications before submitting to Engineer.
9. The Engineer will review the complete submittal package and return five (5) sets to the Contractor with individual items marked in one of the following three forms:

Reviewed as submitted
Reviewed with comments
Disapproved

Items that are disapproved shall be corrected as required and shall be resubmitted to the Engineer for approval.

- B. Approval of submittals, etc. shall not be construed as releasing the Contractor from further responsibility, but rather as a means to coordinate the work and to aid in the proper selection and installation of the materials and equipment. All materials and equipment shall be subject to final acceptance by the Engineer at completion of the project.
- C. Submittal of Record Data:
 1. Record Data: Provide seven (7) sets of record data books containing information listed below. The material shall be bound into appropriately sized 3 ring binders, organized with dividers and index sheets. The binders shall be appropriately labeled with the Owner's name, project name and location. The data books shall include:
 - a. Certified as-built shop drawings for all fabricated equipment.
 - b. Approved product data for all items required in Paragraph 1.09A.
 - c. Spare parts lists
 - d. Test records.
 2. Record Drawings: Provide one (1) set of project drawings marked neatly and legibly in colored pencil to show any significant deviation between actual conditions and original design layout.
 3. Operation and Maintenance Data: Provide seven (7) sets of manufacturer's operation and maintenance data on equipment and components. The data shall be organized into loose-leaf binders with dividers and master index.

1.10 SUBSTITUTIONS:

- A. Requirements for Substitutions: It is the intention of the drawings and specifications to establish a definite standard when a particular manufacturer's product is mentioned. Written request for substitutions of equivalent products will be considered provided all the following conditions are met. Substitutions for specified products will not be permitted unless all of the following conditions are met:
 1. Written request shall be received in the Engineer's office ten (10) days prior to the day of bid opening. Requests after ten days prior to the day of bid opening will not be considered.
 2. Request shall include complete technical data, i.e. product data sheets, curve, ratings, etc.

3. Request shall include a complete written comparison of differences and similarities between the proposed and specified product. Provide a written comparison for each substitution being requested.
 4. Space and clearance requirements are adequate for products mentioned. It is the responsibility of the Contractor to verify space and clearance requirements for products proposed for substitution.
 5. If modifications to the drawings and specifications are necessary for the proper installation of a product proposed for substitution, the request shall explain such in detail, accompanied by drawings if necessary.
- B. Approval: If the above has been complied with, and in the Engineer's opinion the product proposed for substitution is equivalent to that mentioned, the product will be approved for substitution and all prospective bidders will be so notified.

1.11 PROTECTION:

- A. All new work, equipment and materials shall be protected at all times to prevent damage or breakage, either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation. All materials and equipment shall be covered and protected against dirt, water, chemical or mechanical injury. This shall include the erection of all required temporary shelters, cribbing of any apparatus above floor construction and covering of apparatus in incomplete buildings with tarpaulins or other protective covering. Temporary electric heaters shall be installed to keep apparatus dry. All rotating equipment and/or machinery shall be properly lubricated and rotated on a regular basis. All electrical materials and equipment damaged during handling, storage, and installation, until the Owner has accepted the project, shall be repaired or replaced by the Contractor with no increase in contract price.

1.12 COORDINATION:

- A. The Contractor shall not hinder and/or delay any work being accomplished by other construction companies at or near the general construction site; nor shall the Contractor impede normal operation of the Owner at any time except as otherwise indicated.

1.13 WORKMANSHIP:

- A. All labor shall be performed in the best and most workmanlike manner by mechanics skilled in their particular trades. All installations shall be complete in both effectiveness and appearance whether finally enclosed or left exposed. The Engineer reserves the right to direct the removal or replacement of any item which, in his opinion, does not present a reasonably neat or workmanlike appearance, providing that same can be properly installed in an orderly way by usual methods for such work. All specialties and appurtenances shall be installed to conform to the manufacturer's recommendations unless otherwise specified.

1.14 EQUIPMENT BY OTHERS:

- A. This Contractor shall make electrical connections to equipment installed by other trades. The mechanical contractor shall install all motor driven equipment and motors furnished under this contract.
 - 1. The Contractor shall verify the electrical requirements of equipment and appliances furnished by others with data provided by the successful vendor or vendors. The Contractor shall provide the proper sized circuits, circuit breakers, starters, disconnect switches, receptacles, etc. as required to connect this equipment. If changes are required to electrical systems shown on the drawings, the Contractor shall make these changes at no additional cost to Owner.

1.15 CUTTING AND REPAIRING:

- A. The Contractor shall coordinate the work to eliminate cutting of the construction except as specified. Where it becomes necessary to cut through the construction to permit the installation of work or the repair of defective work, it shall be done by mechanics skilled in the trade of erecting the type of work involved. The Contractor without additional compensation shall pay the cost of cutting and repairing. No cutting shall be done to any structural members unless the Engineer grants specific permission, in writing.

1.16 SLEEVES, INSERTS, SUPPORTS, ANCHOR BOLTS, FLASHING AND FOUNDATIONS:

- A. Furnish and install all sleeves, inserts, supports, anchor bolts, flashing, counter flashing and foundations required for the proper installation of the proposed work.

1.17 CLEANING:

- A. All debris resulting from the construction shall be removed from the project site daily. Upon completion of the project, unused materials and equipment shall be removed from the project site. All visible labels, dirt overspray, paint, grease, and stains shall be removed from all electrical equipment. Labels indicating testing laboratory approval or giving parts numbers shall be left in place.

1.18 TESTING:

- A. The Contractor shall test the entire wiring system for proper voltage level and balance, and for short circuits and grounds in accordance with established methods upon completion of work. The system shall operate satisfactorily in every respect. This Contractor shall make all corrections to accomplish such.

1.19 INSPECTIONS:

- A. The Contractor shall cooperate with and provide assistance to the Engineer or the Engineer's Inspector in making periodic and final inspections of the work. This assistance shall include, but not necessarily be limited to, the furnishing of labor, tools, etc. to operate equipment and demonstrate its proper functioning. Also included shall be the removal of outlet, junction box and panel covers, etc. as necessary for the Engineer to inspect the work.

1.20 GUARANTEE:

- A. Any defects from imperfect or improper materials or faults arising from improper workmanship that may appear within a period of twelve (12) months from the date of final acceptance of the system shall be amended and made good by the Contractor at his own cost. Any defects or faults shall be attended to within ten (10) days after receiving written notice from the Engineer. Failure to promptly attend to said defects or faults shall be sufficient cause for the Owner to correct the problem with the Owner's forces or the forces of others and invoice the Contractor for any and all charges, including management and overhead, related to correcting said problem.

END OF SECTION 26 01 00

SECTION 26 06 00 - GROUNDING

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Solid grounding of electrical systems, equipment, machine frames, enclosures, appliances and structures.
2. Basic requirements for grounding for protection of life, equipment, circuits, and systems.
3. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.02 REFERENCES:

A. American Society for Testing and Materials (ASTM):

1. B3 Standard Specification for Soft or Annealed Copper Wire.
2. B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
3. B33 Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. National Fire Protection Association (NFPA):

1. 70 National Electrical Code
2. 78 Lightning Protection Code

C. Underwriters Laboratories Inc. (UL)

1. 467 UL Standard for Safety Grounding and Bonding Equipment.

1.03 SUBMITTALS – FOR APPROVAL:

- A. Procedure: Submit in accordance with Section 013000 and 260100.
- B. Product Data: Submit for grounding conductors, ground rods, clamps, connectors, wells and insulating materials.

1.04 SUBMITTALS – RECORD DATA:

- A. Submit in accordance with Section 013000.

B. Product Data: Approved, as furnished data as listed above.

C. Test Reports

1.05 QUALITY ASSURANCE:

A. Items provided under this Section shall be listed or labeled by UL.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Provide components and installation as required by National Fire Protection Association (NFPA) 70, Article 250.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Provide products in quantities, sizes and ratings to comply with the NEC or the design drawings, whichever requirements are more stringent.
- B. Conductor Materials: Copper
- C. Connector Materials: Copper or bronze, tin-plated where required for corrosion resistance.

2.02 CONDUCTORS:

- A. Grounding Electrode Conductor: Soft drawn copper, Class B stranded per ASTM B-8, 600 volt TW, THW or THWN insulation. Size per NEC 250.
- B. Equipment Grounding Conductor: Soft drawn copper, Class B stranded per ASTM B-8 except that conductor sizes Nos. 12 and 10 AWG used in lighting and receptacle branch circuits may be solid conductor. All conductors shall have 600 volt, TW, THW or THWN insulation.
- C. Grounding Grid Conductor: Medium hard drawn bare copper, Class B stranded per ASTM B-8, No. 2/0 AWG or as otherwise indicated on the drawings.
- D. Color Code: Insulation color shall be green, except that sizes No. 2 AWG and larger may be black with green colored tape spirally applied over all visible surfaces within enclosures.

2.03 WIRE CONNECTORS:

- A. Terminal Lugs: Copper alloy, tin-plated, compression type, Burndy type, YA, NEMA 1 hole for sizes No. 6 through No. 1/0 AWG. Burndy type YGHA, NEMA 2 hole pad for sizes No. 2/0 AWG and larger.
- B. Split Bolt Connectors: Burndy SERVIT, type KS
- C. Taps and Splices:

1. Grounding Grid below Grade: Exothermic type (Cadweld) or compression type (Burndy Hygroud).
2. Above Grade: Compression type.

2.04 CONDUIT CONNECTORS:

- A. Conduit Clamps: Burndy type GAR or GD.
- B. Grounding Bushings: 0-Z/GEDNEY

2.05 GROUNDING ELECTRODES:

- A. Ground Rods: $\frac{3}{4}$ inch diameter, 10 feet long, copper clad steel with high strength sheath, molten welded to core.
- B. Rod Connectors:
 1. Exothermic type: Cadweld
 2. Mechanical type: Burndy type GAR or GD
- C. Test Wells: (Not Required)

2.06 INSULATING MATERIALS:

- A. Tape: Scotch 33+ vinyl plastic.
- B. Mastic Pads: Scotch EZ – Seal

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General:
 1. Provide grounding of systems, equipment and structures in accordance with NEC Article 250, the requirements of the authority having jurisdiction and the design drawings.
- B. Service Entrance:
 1. Provide a main bonding jumper between the service neutral conductor, the service equipment ground bus and the service equipment enclosure.
 2. Provide a grounding electrode conductor to connect the service neutral conductor to the main grounding electrode.

C. Building Steel and Piping:

1. Provide bonding jumper from the service neutral to the building steel and metallic piping systems.

E. Equipment Grounding:

1. Provide a green insulated equipment grounding conductor in all branch circuits and feeder conduits. Size conductor in accordance with NEC 250 unless otherwise indicated on the drawings.
2. Connect the equipment grounding conductor to panelboard or switchgear ground bus and to all metallic raceways, outlet boxes, lighting fixtures, equipment enclosures, appliances and motor frames.
3. Where metallic raceways are installed, both the raceway and the internal equipment grounding conductor shall be utilized for equipment grounding.

F. Grounding Grid:

1. Excavate and backfill for main grounding grid conductor. Locate conductors at least 3 feet away from foundation. Conductor depth shall be 18 to 24 inches below finished grade.
2. Install ground rods vertically in undisturbed soil so that the top of the rod is 18 to 24 inches below finished grade, except that in test wells the top of rods shall be 6 to 8 inches below grade. Space rods a minimum of 10 feet apart.
3. Make underground cable to cable connections using either exothermic or compression type connections.
4. Provide test wells where indicated on the drawings. Install top of test well flush with finished grade or pavement. Use only bolted type rod connectors in test wells.
5. In addition to equipment grounding conductor connections, make connections from the grounding grid to the following items using green, insulated conductors:
 - a. Electrical equipment ground busses
 - b. Electrical equipment enclosures
 - c. Motor frames
 - d. Steel support frames for electrical equipment
 - e. Building steel frame
6. Grounding conductors stubbed up from below grade shall be enclosed in a 1- inch Schedule 40 PVC protective sleeve.

G. Conduit:

1. Provide grounding bushings where metallic conduits connect to non-metallic enclosures or stub-up into open-bottom, floor-mounted enclosures.
2. Provide conduit grounding clamps where metallic conduit stub-ups are connected to non-metallic underground conduits.

H. Testing:

1. Perform a "Fall of Potential" grounding test as described by ANSI/IEEE Standard 81.

- a. Provide ground resistance measurements prior to and after the grounding electrode system is installed.
- b. Ground resistance shall be 5 ohms or less.
- c. Provide additional grounding electrodes a minimum of 10 feet apart to achieve 5 ohms or less.
- d. Provide a signed grounding report to the Engineer and Owner on the Contractor's letterhead with date, time, and resistance measurements of when the tests were completed.

END OF SECTION 26 06 00

SECTION 26 07 50 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Equipment nameplates and labels
2. Warning and caution signs
3. Operational instruction signs
4. Identification labeling of conduits, cables

B. Related Sections:

1. Additional identification requirements are specified in other Sections of Division 26.

1.02 REFERENCES:

A. Code of Federal Regulations (CFR)

1. 29CFR1910.145 Specification for Accident Prevention Signs

B. National Fire Protection Association (NFPA)

1. 70 National Electrical Code

1.03 SUBMITTALS FOR APPROVAL:

- A. Procedure: Submit in accordance with Section 013000 and 260100.
- B. Product Data: Submit for each type of product used on project.
- C. Schedules: Nameplate engraving schedule.

PART 2 - PRODUCTS

2.01 ELECTRICAL IDENTIFICATION PRODUCTS:

A. Engraved Nameplates and Signs:

1. Material: 3 ply plastic laminate, matte-finish, 0.125 inch thickness, white with black center core except that material used for warning signs shall be red with white center core. Provide punched mounting holes for mechanical fasteners.
2. Size: Minimum size to be 1 inch by 2.5 inches, rectangular shape with square corners.

3. Engraving: Accurately align lettering and engrave into center core. Lettering shall be normal block style. Character size shall be 3/8 inch high for grouped equipment and load designation and 1/4 inch for individual equipment, loads and devices.

B. Warning Signs:

1. Fiberglass reinforced polyester, non-adhesive backed, indoor-outdoor with punched mounting holes, Brady B-120.
2. Polyester overlaminated with plastic coating, adhesive-backed, indoor-outdoor, Brady B-302.
3. High Voltage warning signs to read "Danger-High Voltage-Keep Out."
4. Provide identical signs for each application.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General:

1. Provide labels and signs in accordance with NEC requirements.
2. Install labels and signs at locations for best convenience of viewing without interference with operation and maintenance of equipment.
3. All nameplates and signs used on the project shall be of similar size, style and appearance.

B. Equipment Nameplates:

1. Provide engraved identification nameplates for each of the following:
 - a. Panelboards
 - b. Circuit breakers
 - c. Switches
 - d. Contactors
 - e. Pull and junction boxes
2. Nameplate legends shall include the equipment identification number as indicated on the design drawings and an appropriate service description.
3. Nameplates for switchgear assemblies, panelboards, and separately enclosed breakers, switches, starters and contactors shall include the operating voltage.
4. Attach engraved nameplates to equipment with self-tapping, stainless steel, round head screws. Use adhesive attachment only where the substrate material is not suitable for screw attachment.

C. Warning Signs:

1. Voltage warning signs where required by the NEC, where indicated on drawing and as follows:
 - a. Equipment Rooms: On all doors to equipment rooms containing equipment or circuits over 600 volts or containing exposed live parts. Minimum size shall be 7 inches x 10 inches.
 - b. Pull Boxes: On removable covers for all pull and junction boxes containing circuits over 600 volts.
 - c. Equipment: On front and rear compartment access doors and covers enclosing live parts. Signs provided as part of equipment that meet these requirements are acceptable.
 - d. Fences: On each gate and on each side of fences that enclose equipment or circuits over 600 volts or exposed live parts. Minimum size shall be 10 inches by 14 inches. Locate at intervals not exceeding 30 feet.
2. Multiple Source Signs:
 - a. Where enclosures contain voltages from more than one source which are not interrupted by opening the local unit disconnecting means, provide an engraved nameplate bearing the following (or similar) legend:

“WARNING – MULTIPLE ELECTRICAL SOURCES EXIST WITHIN THIS ENCLOSURE”

OR

“WARNING – VOLTAGE MAY BE PRESENT WITH DISCONNECT SWITCH OPEN”
3. Hazardous Operation:
 - a. Where operation of an electric switch or control device may create an unsafe or undesirable operating condition, provide an engraved plastic sign with appropriate warning statement.

D. Multiple Services:

1. Where multiple services exist, provide each service disconnect with an additional sign which states the name and location of other service disconnects.

E. Conduits:

1. Identify conduits at each termination and at all transitions from exposed to concealed or underground installation.
2. Mark conduits legibly with a permanent marker pen to indicate conduit per circuit number.

F. Cables:

1. Identify cables in pull and junction boxes, vaults, manholes and where entering switchgear panelboard assembly.
2. Provide an engraved plastic nameplate or other suitable permanent tag for each cable or cable assembly. Attach with self-locking nylon cable tie.
3. Cable identification shall include circuit number and phase as indicated on drawings.

END OF SECTION 26 07 50

SECTION 26 12 30 - WIRE & CABLE

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section includes copper wire, cable, associated connectors, and termination hardware used on systems operating at 600 volts or less.

1.02 REFERENCES:

- A. American Society for Testing and Materials (ASTM)
 - 1. B8 Concentric-Lay-Stranded Copper Conductor, Hard, Medium Hard, Or Soft.
- B. National Electrical Contractor Association (NECA)
 - 1. Standard of Installation
- C. National Fire Protection Association (NFPA)
 - 1. 70 National Electrical Code
- D. Underwriters Laboratories Inc. (UL)
 - 1. 44 Rubber-Insulated Wires and Cables
 - 2. 83 Thermoplastic-Insulated Wires and Cables
 - 3. 486A Wire Connectors and Soldering Lugs for Use With Copper Conductors
 - 4. 486C Splicing Wire Connectors
 - 5. 510 Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
 - 6. 1569 Metal-Clad Cables

1.03 SUBMITTALS – FOR APPROVAL:

- A. Procedures: Submit in accordance with Section 013000 and 260100.
- B. Product Data: Submit for each type of wire and cable, terminal lugs, connectors, and cable fittings.

1.04 SUBMITTALS – RECORD DATA:

- A. Procedure: Submit in accordance with Section 013000.
- B. Product Data: Approved, as furnished data as listed above.

1.05 QUALITY ASSURANCE:

- A. Furnish wire, cable, associated connectors, and termination hardware bearing UL label.

PART 2 - PRODUCTS

2.01 BUILDING WIRE:

- A. Single conductor, soft drawn, annealed copper conductor, Class B stranded except that sizes No. 10 AWG and smaller used for lighting and power branch circuits may be solid. Insulation shall be 600 volt, type THHN/THWN per UL 83 or type XHHW per UL 44.

2.02 TYPE MC CABLE: Metal Clad Cable type MC multi-conductor cabling as manufactured by AFC Cable Systems or equivalent having the following construction features:

- A. Conductor: Bare, soft annealed copper, Class B stranded per ASTM B-8.
- B. Insulation: Polypropylene tape assembly with 600 volt, 90°C (dry) type THHN insulation with printed number and color identification.
- C. Neutral conductor: White – 120v circuits; Gray – 480Y277v circuits
- D. Grounding conductor: Green insulated copper ground conductor.
- E. Assembly: Three insulated conductors with grounding conductor, non-hygroscopic fillers and overall binder tape per UL 1569.
- F. Sheath: High strength, lightweight galvanized interlocking steel strip and color coded on the out side for easy identification.
- G. U.L rated 1569

2.03 CONNECTORS AND TERMINALS:

- A. Insulated Crimp Type Connectors and Terminals: Nylon insulated, Burndy INSULINK and INSULUG, or Thomas & Betts Sta-Kon.
- B. Split Bolts: High-conductivity copper alloy, Burndy SERVIT or Thomas & Betts Split-Bolt.
- C. Two Bolt Connectors: High-conductivity copper alloy, Burndy OKLIP, Type KVS or Blackburn 2BU.
- D. Compression Terminals: Copper, long barrel, Burndy HYLUG or Thomas & Betts Color-Keyed.
- E. Bolted Terminals: Cast copper alloy, Burndy QIKLUG or Thomas & Betts Locktite.

- F. Spring Wire Connectors: Insulated, twist-on type, Ideal Wire Nut or 3M Scotchlok. Push-in type connectors are prohibited.

2.04 CABLE TERMINATIONS:

- A. Type MC Cable: Steel set screw connectors

2.05 MISCELLANEOUS COMPONENTS:

- A. Tape: UL 510
 - 1. Vinyl Plastic: 3M Scotch 33+ or Scotch 88.
 - 2. Varnished Cambric (VC): 3M Irvington 2920.
 - 3. Friction: Black friction tape.
- B. Pulling Lubricants: Ideal Yellow 77 or Polywater Type J.
- C. Wire Markers:
 - 1. Individual Wires: Heat shrink, machine printed, Raychem.
 - 2. Multi-Conductor Cables or Groups of Wires as a Cable: Nylon tie on marker, Thomas & Betts Nylon I.D. Ties, Ty-Raps.
- D. Wire and Cable Ties: Thomas & Betts Ty-Raps.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. Wire and Cable:
 - 1. THWN-THHN for power wiring through No. 250 AWG and control wiring in conduit. XHHW for sizes above No. 250 AWG in conduit.
 - 2. TW or THW for equipment grounding conductor.
 - 3. Type MC cable for fixture wires no longer than 6' and in accordance with NEC Article 334.
 - 4. No. 12 AWG minimum for power circuits and No. 14 AWG minimum for control circuits unless noted otherwise on drawings.
- B. Splices and Taps:
 - 1. Use insulated spring wire connectors for lighting and receptacle branch circuits No. 10 AWG and smaller. Push-in type connectors are prohibited.
 - 2. Use solderless pressure connectors for branch circuit conductors No. 8 AWG and larger.

3. Do not make splices or taps in feeder circuits or control circuits.

C. Terminals:

1. Use copper compression terminals, NEMA 1 hole for sizes No. 4 AWG and smaller, NEMA 2 hole for sizes No. 2 AWG and larger.
2. Use insulated, ring tongue terminals for signal and control conductors.

3.02 INSTALLATION:

A. Install wire and cable in accordance with the NECA Standard of Installation.

B. Installation in Conduit:

1. Swab conduits completely and thoroughly before pulling in conductors.
2. Pull all conductors into conduit at same time.
3. Use suitable wire pulling lubricant for building wire No. 4 AWG and larger.
4. Do not pull in conductors until conduit system is completed. Do not pull through boxes, fittings or enclosures where a change of conduit alignment or direction occurs.
5. Limit pulling tension to maximum values as recommended by manufacturer.
6. Do not combine circuits into a common conduit other than as indicated on the drawings.

C. Direct Burial Cable:

1. Trench and backfill for direct burial cables. Minimum depth of installation shall be 24 inches.
2. Terminate and ground metallic cable sheath with suitable fittings.

D. Compression Connectors and Terminals:

1. Install on wire and cable with approved tool and die to recommended compression pressure. Do not cut strands from conductors to fit lugs or terminals.

E. Bolted Connectors and Terminals:

1. Torque to manufacturer's recommended foot-pounds for size and class of connector.
2. Where manufacturer's published torquing requirements are not indicated, tighten connectors and terminals to comply with UL 486A torque values.
3. Use galvanized steel bolts, nuts, split-lock washers and flat washers on terminal connections.

F. Wiring in Enclosures:

1. Form and tie conductors in panelboards, cabinets, control panels, motor controllers, wireways, and wiring troughs in a neat and orderly manner.
2. Use Thomas & Betts wire and cable ties of appropriate size and type.

3. Limit spacing between ties to not more than 6 inches.

G. Taping:

1. Above Ground and Dry Locations: Fill voids and irregularities with half-lapped layers of VC (two minimum) or electrical insulation putty. Insulate with three half-lapped layers of vinyl plastic and one half-layer of friction tape.
2. In damp or wet locations, wrap insulated spring wire connectors with 2 layers of vinyl plastic tape.

3.03 COLOR CODING:

- A. Power Wiring: Provide color coding for single and multi-conductor power circuits as follows:

<u>Voltage</u>	<u>ΦA</u>	<u>ΦB</u>	<u>ΦC</u>	<u>Neutral</u>
240 volts and below	Black	Red	Blue	White
250 – 600 volts	Brown	Purple	Yellow	Gray

1. For specified insulation and jackets not manufactured with integral colors, use conductors with black insulation or jacket and color-coding tape.
2. Color code conductors entering boxes, troughs, cabinets, and other enclosures.
3. Color code conductors in wireways, trenches, and other locations where conductors are continuously accessible at intervals not exceeding 5 feet.

- B. Insulated Equipment Ground: Green.

- C. Isolated Ground conductor: Green with Yellow tracer.

3.04 WIRING IDENTIFICATION

- A. Control Circuits: Install a permanent wire label at each termination. Identifying numbers shall match approved schematic and wiring diagrams.
- B. Feeder and Branch Circuits: Install a permanent wire label at each termination. Identifying numbers shall include source panel designation and circuit number.

3.05 FIELD TESTS:

- A. Test conductors after installation is complete and prior to connection to equipment.
- B. Perform insulation resistance test on each conductor phase-to-ground with adjacent conductors grounded and test conductor disconnected from equipment. Applied potential shall be 1000 volts dc for one minute. Minimum acceptable test values shall be 50 megohms. Investigate deviations in test values between adjacent phases.

- C. Verify tightness of bolted connections with a calibrated torque wrench. Torque values shall be terminal lug manufacturer's recommendations.

END OF SECTION 26 12 30

SECTION 26 13 60 - RACEWAYS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Rigid Galvanized Steel Conduit (RGS)
2. PVC-Coated Rigid Steel Conduit (CRGS)
3. Rigid Aluminum Conduit (RAC)
4. Electrical Metallic Tubing (EMT)
5. PVC Conduit (PVC)
6. Flexible Conduit
7. Associated Fittings
8. Wireways
9. Pull and Junction Boxes

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. C80.1 Rigid Steel Conduit – Zinc Coated
2. C80.3 Electrical Metallic Tubing – Zinc Coated
3. C80.5 Rigid Aluminum Conduit

B. National Electrical Manufacturers Association (NEMA):

1. TC 2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
2. TC 3 PVC Fitting for Use with Rigid PVC Conduit and Tubing
3. TC 13 Electrical Nonmetallic Tubing (ENT)
4. TC 14 Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

C. National Fire Protection Association (NFPA):

1. 70 National Electrical Code

D. Underwriters Laboratories Inc. (UL):

1. 1 Flexible Metal Conduit
2. 5 Surface Metal Raceways and Fittings
3. 5A Nonmetallic Surface Raceways and Fittings
4. 6 Rigid Metal Conduit
5. 360 Liquid-Tight Flexible Steel Conduit
6. 514B Fittings for Conduit and Outlet Boxes
7. 797 Electrical Metallic Tubing
8. 870 Wireways, Auxiliary Gutters, and Associated Fittings

9.	886	Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
10.	1660	Liquid-Tight Flexible Nonmetallic Conduit

1.03 SUBMITTALS – FOR APPROVAL:

- A. Procedure: Submit in accordance with Section 013000 and 260100.
- B. Product Data: Submit for each type of conduit, fitting, connector, pull and junction box, and wireway used on the project.

1.04 SUBMITTALS – RECORD DATA:

- A. Procedure: Submit in accordance with Section 013000.
- B. Product Data: Approved, as furnished data as listed above.

PART 2 - PRODUCTS

2.01 RIGID GALVANIZED STEEL (RGS):

- A. Conduit: Conduit including elbows, couplings, and nipples shall be standard weight zinc-coated steel, rigid threaded conduit; shall meet the requirements of ANSI C80.1; and shall be hot-dipped galvanized inside, outside and over threads and lacquered inside.
- B. Fittings: Conduit fittings and accessories for use with RGS conduit shall be cast malleable iron or ferrous alloy, hot-dipped galvanized or zinc-electro-plated and lacquered. Fittings shall have threaded hubs and gasketed covers. Fittings shall be the product of Crouse-Hinds, Appleton or Gedney or an equal.
- C. Boxes: Device and outlet boxes for use with RGS conduit shall be cast malleable iron, hot-dipped galvanized or zinc-electro-plated and lacquered. Boxes shall have threaded hubs and gasketed covers. Boxes shall be the product of Crouse-Hinds, Appleton, Gedney or equal.
- D. Fasteners and Supports: All clamps, straps, framing and supporting materials shall be hot-dipped galvanized steel or malleable iron. Bolts, nuts, screws, washers, etc. shall be stainless steel. Cadmium-plated or zinc-plated fasteners and hardware will not be acceptable.

2.02 POLYVINYL CHLORIDE (PVC - SCHEDULE 40):

- A. Conduit: Conduit, elbows and couplings shall be Schedule 40 rigid polyvinyl chloride (PVC) conduit per NEMA TC 2 with a 90° UL rating, and shall be the standard product of Krayloy or Carlon or approved equal.
- B. Fittings: Fittings and accessories for use with Schedule 40 PVC conduit shall conform to NEMA TC 3 and shall be of the same material and manufacturer as the conduit.

2.03 PVC COATED STEEL CONDUIT (CRGS):

- A. Conduit: Prior to coating, all conduits, elbows, couplings, nipples etc. shall be standard weight rigid, threaded steel and shall be hot dipped galvanized inside and out and over the ends. The conduit shall meet the requirements of ANSI C80.1, UL 6, and NEMA RN-1, 1980.
- B. Fittings: Prior to coating, fittings shall be cast malleable iron, hot dipped galvanized, Appleton Form 35 or Crouse-Hinds or equivalent with cast cover and neoprene gasket.
- C. Boxes: Device and outlet boxes for use with PVC coated conduit shall be cast malleable iron, hot dipped galvanized with threaded hubs and gasketed cast covers or device plates. Boxes shall be the product of Appleton or Crouse-Hinds.
- D. PVC Coating: Conduit, fittings, boxes and accessories shall be Plasti-Bond 2 coated, as produced by Robroy Industries Inc. or an approved equal. Before coating, the galvanized surfaces shall be coated with an epoxy-acrylic primer. Exterior surfaces shall have a 40 mil PVC coating applied by dip method. Interior surfaces of conduits, fittings, boxes, etc. shall have a fusion bonded phenolic coating with a thickness of 4-6 mils.
- E. Fasteners and Supports: U-bolts, conduit clamps, straps, modular framing channels shall be 1-5/8" x 1-5/8" minimum section dimensions, Type 304 stainless steel, and shall be the product of Unistrut. Fasteners and attachment hardware shall be Type 304 stainless steel.

2.04 RIGID ALUMINUM CONDUIT:

- A. Conduit: Conduit, including elbows, couplings and nipples shall be standard weight, threaded, rigid aluminum 6063 alloy, with a copper content not to exceed 0.20%. The conduit shall have a silicon or lacquer coating inside.
- B. Fittings: Fittings, accessories and device boxes for aluminum conduit systems shall be the standard threaded type as manufactured by Crouse-Hinds, Appleton, or equal. Both fittings and covers shall be aluminum containing less than 0.4 of 1% copper. All screws shall be stainless steel. Covers shall be gasketed.
- C. Fasteners: All straps and clamps used to support aluminum conduit shall be hot-dipped galvanized steel or malleable iron, with a 40 mil fused PVC coating, Plastibond, Ocal or equivalent. Strut type framing channels shall be either PVC coated galvanized steel or fiberglass.
- D. Hardware: Nuts, bolts, screws, washers, etc. shall be stainless steel. Galvanized or cadmium-plated hardware will not be acceptable for use with aluminum conduit.

2.05 ELECTRICAL METALLIC TUBING (EMT):

- A. Conduit: Conduit, including elbows, couplings, and nipples shall be hot dipped galvanized steel inside and out with an organic corrosion resistant coating applied to the inside.
- B. Fittings and Boxes: Conduit fittings, boxes, and accessories for use with EMT conduit shall be cast malleable iron or ferrous alloy, hot-dipped galvanized or zinc-electro-plated and lacquered.

Fittings shall be compression type. Setscrew fittings are not acceptable. Fittings shall be the product of Crouse-Hinds, Appleton, OZ Gedney or an equal.

- C. Fasteners and Supports: All clamps, straps, framing and supporting materials shall be hot-dipped galvanized steel or malleable iron.

2.06 LIQUID-TIGHT FLEXIBLE METAL CONDUIT:

- A. Flexible Conduit: Flexible conduit shall have a spiraled, flexible, galvanized steel inner core and an outer jacket of neoprene. Sizes 3/8" through 4" shall have a continuous, internal copper ground. Liquid-tight connectors shall be galvanized steel or malleable iron with neoprene sealing gaskets, external ground lugs and insulated throats. Connectors shall be Appleton type STB or Gedney or equal.

2.07 WIREWAYS:

- A. Sheet Metal:
1. Indoor, dry locations: NEMA 1, sheet steel per UL 870 with hinged cover per NEMA ICS 6. Finish being manufacturer's standard gray enamel.
 2. Outdoor and damp locations: NEMA 3R, galvanized sheet steel per UL 870 with hinged cover per NEMA ICS 6.
- B. Non-Metallic:
1. NEMA 4X, Robroy Industries fiberglass trough with gasketed cover attached with non-metallic fasteners.
- C. Fittings and Accessories: Include couplings, hubs, elbows, adapters, end caps and other fittings to match and mate with type of wireway furnished as required for a complete system.

PART 3 - EXECUTION

3.01 APPLICATION:

- A. General:
1. All field wiring shall be installed in conduit except as otherwise indicated.
 2. Minimum conduit size shall be 1/2-inch nominal diameter.
- B. Exposed:
1. Conduit installed outdoors exposed shall be rigid galvanized steel.
 2. Conduit installed indoors exposed and below 7 feet shall be rigid galvanized steel. Exposed conduit above 7 feet installed indoors may be EMT.
- C. Underground:

1. Conduit installed underground shall be Schedule 40 PVC. See section 3.02-E for additional requirements.
2. Elbows used for underground conduit stub-ups from below grade shall be PVC coated rigid galvanized steel, non-metallic Schedule 80 PVC, or Rigid Galvanized Steel completely taped with non-corrosive protective tape.

D. Concealed:

1. Conduit installed concealed above lay-in ceilings and in dry wall construction shall be EMT.

E. Flexible Connections:

1. Indoor-dry areas: Flexible metal conduit.
2. Indoor-wet, damp areas: Liquid-tight, flexible metal conduit.
3. Outdoors: Liquid-tight, flexible metal conduit.

3.02 INSTALLATION:

A. General:

1. Installation Methods: Conduit shall be installed concealed in walls or above ceiling or underground as indicated on the drawings.
2. Cleaning: All conduit systems shall be completed and shall be swabbed clean before conductors are pulled in.
3. Field cuts: Do not cut conduit with pipe cutters.
4. Bends: Field made bends and offsets shall be made with a hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. The maximum number of 90° bends, or equivalent between pulling points in any conduit run shall be three. Pull and junction fittings and/or boxes shall be provided as necessary to satisfy this requirement.
5. Protection: The ends of all conduit runs shall be closed immediately after installation to prevent the accumulation of water, dirt and other foreign material.
6. Locknuts: Conduits shall be fastened to all sheet metal boxes and cabinets with two locknuts. Locknuts shall have sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be the insulating type.
7. Conduit couplings shall be threaded type for RGS or RA conduit and compression type for EMT conduit. Set-screw couplings are not acceptable.
8. Spare conduits: Spare conduits shall have a pull cord installed. The pull cord shall be plastic with a minimum tensile strength of 200 pounds. Not less than 12 inches of slack shall be left at each end of the pull cord.
9. Supports: Supports shall be provided a minimum of every 10' and within 3' of all enclosures. In addition, conduits shall be rigidly supported between couplings, on either side of bends and at terminations and fittings.
10. Boxes: Boxes shall be provided in the raceway system as indicated on the drawings and also wherever required for pulling of wires or making connections. Unless otherwise shown on the drawings, boxes installed in normally wet locations or on the outside of exterior surfaces shall be NEMA 3R, stainless steel sheet construction.

Boxes shall be furnished with hinged and gasketed doors and stainless steel back panels. Each box shall have the volume required by the NEC for the number of conductors enclosed in the box. All boxes shall be securely anchored in place.

11. Flexible Connections: Flexible connections of short length shall be provided for equipment subject to vibration, noise transmission or movement. A separate ground conductor shall be provided across all flexible connections. Flexible conduit connections shall be rigidly and securely supported in an approved manner at intervals not exceeding 24 inches in length and within 12 inches of each conduit termination. Lengths of not more than 36 inches may be installed without such supports where flexibility is required.
12. Identification: Identify conduits in accordance with Section 260750.
13. PVC: PVC conduit joints shall be solvent cement welded and shall be watertight. All PVC conduits shall have a separate grounding conductor installed. Where transition is made to the metallic conduit or enclosures, the grounding conductor shall be bonded to the metal conduit or enclosure.
14. Penetrations through walls, floors, and roof: All penetrations shall be sealed with a UL listed fire sealant equal to Dow Corning #3-6548.

B. Exposed Conduit:

1. Routing: Exposed conduit shall be run straight and true to structure lines. Changes in direction of runs shall be made with fittings or symmetrical bends. Conduit in damp locations or outdoors shall be exposed to the air on all sides and shall not be installed tight against walls, ceilings and structural members, etc. Clamp backs and/or offsets shall be used as necessary to maintain uniform clearances.
2. Supports: Acceptable supporting and clamping materials for exposed conduit include one-hole straps and clamp back, "U" bolts, parallel or right angle conduit clamps, hot-dipped galvanized structural steel frames or modular stainless steel channel as manufactured by Unistrut or equal. Perforated steel tape, stamped steel one- and two-hole straps shall not be used. Conduits shall be supported in accordance with NEC 346-12.
3. Obstructions: Conduit shall be routed so as not to create any tripping or head banging hazard and so as not to create any obstruction to Owner's operation and maintenance activities.
4. Hubs: Watertight conduit hubs shall be installed where conduits enter the tops or sides of sheet metal or non-metallic enclosures.
5. Drains: Drain fittings shall be installed at low points throughout the conduit system where condensation is likely to occur.

C. PVC Coated Conduit:

1. PVC coated conduit requires special care to minimize damage to the PVC coating during cutting, threading, bending and installation. Contractor shall install conduit in accordance with manufacturer's recommended installation procedures.
2. Contractor shall be responsible for providing strap wrenches, cutting dies, vises, and other special tools required to install PVC coated conduit. Standard pipe wrenches, chain wrenches or channel locks shall not be used. Conduit bending equipment shall have the proper diameter shoes or dies to allow for the thickness of the PVC coating.
3. PVC coated conduit shall be supported with Type 304 stainless steel clamps, straps, hangers and supports. Attachment hardware shall be Type 316 stainless steel.

4. All PVC coated conduit and fittings that have teeth marks, cuts, nicks or are otherwise damaged shall be repaired by coating damaged area with a liquid PVC touch-up compound. Spray-type compound is not acceptable.
5. Unistrut channel supports and related accessories for use with PVC coated conduit shall be Type 304 stainless steel.

D. Aluminum:

1. Aluminum conduit shall not be installed in direct contact with earth, concrete, steel, copper, brass or bronze. Where aluminum conduit comes into contact with dissimilar metals or passes through concrete walls or floors, it shall be wrapped with 2 layers, half-lapped, of corrosion preventative pipe tape, Scotch 50 or equal.
2. Aluminum conduit threads shall have a Penetrox, No-Ox-Ide or equal, applied when installed.

E. Underground Conduit:

1. Under Landscaping (i.e. sod or grass):
 - a. Underground conduits 2" and larger shall be laid in sand and covered with a 4" red concrete cap. The conduit shall be surrounded by a minimum of 3-inches of virgin sand (top, bottom, and sides).
 - b. The top of concrete cap shall be a minimum of 24 inches below grade.
 - c. Communication conduits shall be buried a minimum of 36" to top of conduit.
 - d. Provide red caution tape 12" below finish grade over all conduits.
 - e. Unless otherwise indicated, electrical conduits must go below conflicts, such as yard piping, if the minimum depth cannot be met. Backfill for all trenches shall be compacted to original density.
2. Under Paved Areas (i.e. Parking Lot, Driveways, and Roads):
 - a. Underground communication conduit runs shall be buried a minimum 36" below grade to top of conduit. Provide red caution tape 12" below finish grade over all conduits.
 - b. Underground power conduit runs shall be buried the minimum depth per the National Electric Code. Provide red caution tape 12" below finish grade over all conduits.
 - c. Unless otherwise indicated, electrical conduits must go below conflicts, such as yard piping, if the minimum depth cannot be met. Backfill for all trenches shall be compacted to original density.
3. Separation: Minimum separation between the outside edges of adjacent conduits shall be 3 inches.
4. Elbows: All elbows shall be long radius type.
5. Spacers: Conduit spacers shall be installed at 5 feet on centers.
6. Expansion Fittings: Provide expansion fittings in aboveground, vertical portion of each underground conduit stub-up.

END OF SECTION 26 13 60

SECTION 26 14 00 - WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Receptacles
2. Ground Fault Circuit Interrupter Receptacles
3. Snap Switches
4. Wall Plates

1.02 REFERENCES:

A. National Electrical Manufacturers Association (NEMA):

1. WD1-83 General Requirements for Wiring Devices
2. WD-5 Specific Purpose Wiring Devices

B. National Fire Protection Association (NFPA):

1. 70 National Electrical Code

C. Underwriters Laboratories Inc. (UL):

1. 20-86 Standard for Safety General Use Snap Switches
2. 94-91 Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
3. 498091 Standard for Safety Attachment Plugs and Receptacles

1.03 SUBMITTALS:

- A. Procedures: Submit for approval and record purposes in accordance with Section 013000 and 260100.
- B. Product Data: Submit for each type of device used on project.

1.04 QUALITY ASSURANCE:

- A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 2. Terms "listed" and "labeled" shall be defined as they are in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

PART 2 - PRODUCTS

2.01 WIRING DEVICES:

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA Standards.
- B. Receptacles, General Use Duplex Receptacles: 125 volt, 15 or 20 amp, heavy duty, grounding type, TAMPER RESISTANT, by Hubbell, Leviton, or P&S. Device color shall be selected by the Architect.
- C. Ground-Fault Circuit Interrupter (GFCI) Receptacles: 125 volt, 15 or 20 amp, heavy duty, grounding type "non feed-through" conforming to UL 498 and UL 943 by Hubbell, Leviton, or P&S. Device color shall be selected by the Architect.
- D. Snap Switches: 120/277 volt, 20 ampere, quiet rated, heavy duty, complying with UL 20 and NEMA WD1 by Hubbell, Leviton, or P&S. Device color shall be selected by the Architect.

2.02 WIRING DEVICE ACCESSORIES:

- A. Wall Plates:
 1. Single and combination, of types, sizes, and with ganging and cutouts as required by devices.
 2. Provide plates which mate and match with wiring devices to which attached.
 3. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates.
 4. Provide plates possessing following additional construction features.
 - a. Device plates: Stainless steel. Color to match device
 - b. Device plates for surface mounted, 4 inch sq boxes: 1/2 inch stainless steel covers.
 - c. Weatherproof covers for exterior devices or devices in damp locations: Raintight while in use, UL listed, molded UV stabilized poly-carbonate with stainless steel screws and mounting gaskets. Tay Mac Corporation safety outlet enclosure, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

WIRING DEVICES

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes that are clean; free from building materials, dirt and debris.
- D. Mounting Heights: Unless otherwise indicated or directed, boxes for wiring devices shall be mounted so that the centerline of the device is at the following height above finished floor (AFF) or above finished grade (AFG).

DEVICE	FINISHED AREAS	UNFINISHED AREAS
Snap switches	48"	48"
Convenience Receptacles	18"	18"

- E. Install wiring devices after wiring work is completed.
- F. Install wall plates after painting work is completed.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A. Use properly scaled torque indicating hand tool.
- H. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.
- I. Ground receptacles with insulated green ground wire from device ground screw to bolted outlet box connection.

3.02 PROTECTION:

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.03 FIELD QUALITY CONTROL:

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six (6) times.

- B. Test receptacles with Hubbell 5200, Woodhead 1750 or equal for correct polarity, proper ground connection and wiring faults.
- C. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer's recommendations.

END OF SECTION 26 14 00

26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE:

- A. Furnish and install panelboards as specified herein and as indicated on the drawings.
- B. Panelboard types included in this Section are:
 - 1. Power distribution panelboards
 - 2. Lighting and appliance panelboards

1.02 REFERENCES:

- A. National Electrical Contractors Association (NECA)
 - 1. Standard of Installation
- B. National Electrical Manufacturers Association (NEMA)
 - 1. AB 1 Molded Case Circuit Breakers
 - 2. PB 1 Panelboards
 - 3. PB1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. Underwriters Laboratories Inc. (UL)
 - 1. 50 Cabinets and Boxes
 - 2. 67 Panelboards

1.03 SUBMITTALS - FOR APPROVAL:

- A. Procedure: Submit in accordance with Section 013000, 260100, and as stated herein.
- B. Product Data:
 - 1. Descriptive bulletins
 - 2. Enclosure outline drawing with complete dimensions
 - 3. Breaker layout drawing
 - 4. Component list
 - 5. Conduit entry/exit locations
 - 6. Assembly ratings including:
 - a. Short circuit current
 - b. Voltage
 - c. Continuous current

7. Cable terminal sizes.
8. Installation Instructions

1.04 SUBMITTALS – RECORD DATA:

- A. Procedure: Submit in accordance with Section 013000.
- B. The following information shall be submitted for record purposes:
 1. Final (as-built) drawings and information for items listed in Paragraph 1.03
 2. Installation, operation and maintenance instruction
 3. Spare parts list

1.05 QUALIFICATIONS:

- A. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.
- B. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

1.06 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.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

- A. Cutler-Hammer
- B. Square D
- C. Siemens
- D. ABB

2.02 RATINGS:

- A. Panelboards rated 240 Vac or less shall have short circuit ratings as indicated on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.
- B. Panelboards rated 480 Vac shall have short circuit ratings as indicated on the drawings or as herein scheduled, but not less than 14,000 amperes RMS symmetrical.

- C. Panelboards shall be labeled with a UL short circuit rating. All panelboards shall be fully rated. Series ratings shall not be used.

2.03 CONSTRUCTION:

- A. Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- B. Trims for lighting and appliance panelboards shall be supplied with a hinged door covering all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semiflush, cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.
- C. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.
- D. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 inch on all sides. Trims shall be secured to box with concealed clamps.
- E. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door in a metal frame.
- F. All locks shall be keyed alike.

2.04 BUS:

- A. Main bus bars shall be tin-plated copper, sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65⁰ C above an ambient of 40⁰ C maximum.
- B. A bolted ground bus shall be included in all panels.
- C. Full-size (100%-rated) insulated neutral bars shall be included for panelboards indicated to have a neutral bus. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200%-rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.05 DISTRIBUTION PANELBOARDS:

- A. Distribution panelboards including circuit breakers contained therein shall have fully rated interrupting ratings as indicated on the drawings. Panelboards shall have bolt-on, molded case circuit breakers as indicated below.
- B. Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics. Ground fault protection shall be provided where indicated.

- C. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break, over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- D. Where indicated, circuit breakers shall be current limiting.
- E. Circuit breakers below 600-ampere shall have thermal-magnetic trip units and inverse time-current characteristics.
- F. Circuit breakers 600-ampere through 1200-ampere shall be provided with microprocessor-based RMS sensing trip units.
 - 1. Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
 - 2. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.
 - 3. The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
 - 4. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes. Provide neutral ground fault current sensor for four-wire loads.
 - 5. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker, by means of a 120-volt operated test set. Provide one test set capable of testing all breakers 600-ampere and above.
 - 6. System coordination shall be provided by the following microprocessor-based, time-current curve shaping adjustments:
 - Adjustable long-time pick-up
 - Adjustable short-time pick-up and delay, with selective curve shaping
 - Adjustable instantaneous pick-up
 - Adjustable ground fault pick-up and delay, with selective curve shaping.
- G. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
- H. Provide shunt trips, bell alarms, and auxiliary switches as indicated on the drawings.

- I. Circuit breakers supplying air conditioning branch circuits shall be UL listed as type HACR.

2.06 LIGHTING AND APPLIANCE PANELBOARDS:

- A. The minimum integrated short circuit rating for branch circuit panelboards shall be indicated on the drawings.
- B. Bolt-in type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
- C. Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits and HACR for air conditioning branch circuits.
 - 1. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management and control system (EMCS) panels and fire alarm panels.

2.07 ENCLOSURE:

- A. General: Enclosures shall be at least 20 inches wide and made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided. Enclosures shall be provided with blank ends.
- B. Rating: NEMA type 12 enclosure except where other enclosure requirements are indicated.

2.08 FINISH:

- A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of the manufacturers standard paint color shall be applied.

2.09 MISCELLANEOUS DEVICES

- A. Provide TVSS system integral to distribution panelboards and appliance panelboards where indicated on drawings. Reference section 266710 for specifications on TVSS units.

PART 3 – EXECUTION

3.01 EXAMINATION:

- A. Confirm installation space and clearance requirements for panelboards in accordance with NEC requirements.

3.02 INSTALLATION:

- A. General: Install panelboards as indicated on the drawings and in accordance with manufacturer's published instructions, NEMA PB 1.1, and NECA "Standard of Installation".
- B. Mounting Heights: Top of trim 6 feet 2 inches above finished floor, except as otherwise indicated.
- C. Mounting:
 - 1. Plumb and rigid without distortion of box.
 - 2. Mount flush panels uniformly flush with wall finish.
- D. Circuit Directory: Typed directory indicating final circuit connections. Obtain approval before installing.
- E. Install filler plates in unused breaker spaces.
- F. Provisions for Future Circuits at Flush Panelboards:
 - 1. Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.
 - 2. Stub four 1-inch empty conduits into raised floor space or below slab other than slabs on grade.
- G. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.03 IDENTIFICATION:

- A. Identify field-installed wiring and components and provide unit nameplate in accordance with Section 260750.
- B. Provided one (1) 8-1/2"x11" stainless steel nameplate engraved with one-line diagram and year installed. One-line diagram shall include panel voltages, amps, AIC ratings, and feeder sizes. Nameplate shall be mounted to the exterior door of the main distribution panel – LB.

3.04 GROUNDING:

- A. Connections: Make equipment grounding connections for panelboards as required in Section 260600.
- B. Provide ground continuity to main electrical ground bus.
- C. Provide isolated ground bars for panels serving sensitive electronic equipment and as indicated on panel schedules.

3.05 CONNECTIONS:

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.06 FIELD TESTING:

- A. Inspect for compliance with drawings and specifications.
- B. Inspect for defects, damaged or missing parts.
- C. Operate each breaker a minimum of three (3) times to insure proper operation.
- D. Perform insulation resistance test on complete assembly at 1000 Vdc. Disconnect any solid-state devices prior to testing. Minimum acceptable test results are 100 megohms.

3.07 CLEANING:

- A. Upon completion of installation, inspect interior and exterior of panelboards.
- B. Remove paint splatters and other spots, dirt, and debris.
- C. Touch up scratches and mars of finish to match original finish.
- D. Clean interior of panelboard.

3.08 FIELD ADJUSTMENTS:

- A. Balancing Loads: Prior to final acceptance, conduct load-balancing measurements and circuit changes as follows:
 - 1. Perform measurements during period of normal working load as advised by Owner.
 - 2. Advise Engineer of load imbalances exceeding 20% or of loads exceeding 80% of circuit ratings. Reconnect branch circuit loads as directed by Engineer.

3. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical circuits.
4. Recheck loads after circuit changes during normal load period. Record load readings before and after changes and submit test records.

END OF SECTION 26 24 16

SECTION 26 43 13 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. This section describes the materials and installation requirements for surge protective devices (SPD) for the protection of all AC electrical circuits.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Other sections that may relate to the work in this section include, but are not limited to, the following:
 - 1. Section 26 24 13.11 – Switchboards
 - 2. Section 26 24 16 – Low-Voltage Panelboards

1.3 SUBMITTALS

- A. Submit shop drawings and product information for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by customer name, customer location, and customer order number.
- B. Submittals shall include UL 1449 4th Edition Listing documentation verifiable by visiting www.UL.com, clicking “Certifications” link, searching using UL Category Code: VZCA.
 - 1. Short Circuit Current Rating (SCCR)
 - 2. Voltage Protection Ratings (VPRs) for all modes
 - 3. Maximum Continuous Operating Voltage rating (MCOV)
 - 4. I-nominal rating (I-n)
 - 5. SPD shall be Type 1 UL listed and labeled
- C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.
- D. Minimum of ten (10) year warranty

1.4 RELATED STANDARDS

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,

- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Code: Article 285
- E. UL 1283 - Electromagnetic Interference Filters
- F. UL 1449, Fourth Edition – Surge Protective Devices

1.5 LISTING REQUIREMENTS

- A. SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm with at least ten (10) years experience in manufacturing transient voltage surge suppressors.
- B. Manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Handle and store equipment in accordance with manufacturer’s Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide an externally mounted transient voltage suppressors by Siemens or pre-approved equal. Approved manufacturers are as follows:
 - 1. ABB
 - 2. ADP
 - 3. THOR

2.2 SURGE PROTECTIVE DEVICE FEATURES SURGE PROTECTION DEVICES

- A. SPD shall be UL 1449 listed and labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
- B. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnects do not meet the intent of this specification.
- C. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
- D. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
- E. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- F. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
- G. SPD shall meet or exceed the following criteria:
 - 1. Minimum surge current capability (single pulse rated) per phase shall be:
 - a. Service Entrance applications:
 - 1.) Siemens Model TPS3 12 with Maximum 7-Mode surge current capability shall be 250kA per phase.
 - b. Distribution applications:
 - 1.) Siemens Model TPS3 09 with Maximum surge current capability of 100kA per phase
 - 2. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

- H. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) for L-N, L-G, and N-G modes of protection (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

- I. Service Entrance SPD shall be complimentary UL 1283 listed for EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
- J. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

- K. Service Entrance SPDs shall be equipped with the following diagnostics:
 - 1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - 2. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - 3. Form C dry contacts
 - 4. Optional – Surge Counter
 - 5. No other test equipment shall be required for SPD monitoring or testing before or after installation.
- L. Distribution Panels SPDs shall be equipped with the following diagnostics:
 - 6. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - 7. Audible Alarm & Dry Contacts
 - 8. No other test equipment shall be required for SPD monitoring or testing before or after installation.

PART 3 - EXECUTION

3.2 INSTALLATION

- A. The installation shall meet the following criteria:
 - 1. Install per manufacturer's recommendations and contract documents.
 - 2. Install units plumb, level and rigid without distortion
 - 3. One primary suppressor shall be installed external to the service entrance in accordance with manufacturer instructions.
 - 4. Service Entrance SPD shall be installed on the line or load side of the main service disconnect.
 - 5. Service Entrance SPD ground shall be bonded to the service entrance ground.
 - 6. At Service Entrance or Transfer Switch, a UL approved disconnect switch shall be provided as a means of servicing disconnect if a 60A breaker is not available.
 - 7. One SPD shall be installed external to each designated distribution panelboard.
 - 8. At Distribution, MCC and Branch, SPD shall have an independent means of servicing disconnect such that the protected panel remains energized. A 30A breaker (or larger) may serve this function.
 - 9. SPD shall be installed per manufacturer's installation instructions with lead lengths as short (less than 24") and straight as possible. Gently twist conductors together.
 - 10. Installer may reasonably rearrange breaker locations to ensure short & straightest possible leads to SPDs.
 - 11. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.

3.3 ADJUSTMENTS AND CLEANING

- A. Remove debris from SPD and wipe dust and dirt from all components.
- B. Repaint marred and scratched surface with touch up paint to match original finish.

3.4 TESTING

- A. Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.
- B. Check all installed panels for proper grounding, fastening and alignment.

3.5 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operations, but not more than eighteen months from date of shipment.

END OF SECTION 26 43 13

SECTION 26 44 10 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the low-voltage fused and non-fused switches as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

1.03 REFERENCES

- A. The switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL.

1.04 SUBMITTALS -- FOR REVIEW/APPROVAL

- A. Procedure: Submit in accordance with Section 013000, 260100, and as stated herein.
- B. The following information shall be submitted to the Engineer:
 - 1. Master drawing index
 - 2. Dimensioned outline drawing
 - 3. Conduit entry/exit locations
 - 4. Switch ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 5. Fuse ratings and type
 - 6. Cable terminal sizes.

1.05 SUBMITTALS -- FOR INFORMATION

- A. When requested by the Engineer the following product information shall be submitted:
 - 1. Descriptive bulletins
 - 2. Product sheets.

1.06 SUBMITTALS--FOR CLOSEOUT

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in section 1.04

1.07 QUALIFICATIONS

- A. FOR THE EQUIPMENT SPECIFIED HEREIN, THE MANUFACTURER SHALL BE ISO 9000, 9001 OR 9002 CERTIFIED.

1.08 NOT USED

1.09 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.

1.10 FIELD MEASUREMENTS

- A. Contractor shall field verify all dimensions prior to installation. Installation of all switches shall comply with the National Electric Codes clearance and mounting height requirements.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Three (3) copies of these instruction manuals shall be submitted with the closeout documents listed in section 1.06.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Square D
- B. ABB
- C. Siemens
- D. Eaton

2.02 DISCONNECT SWITCHES

- A. Provide switches as shown on drawings, with the following ratings:
 - 1. 30 to 1200 amperes
 - 2. 250 volts AC, DC; 600 volts AC (30A to 200A 600 volts DC)
 - 3. 2, 3, 4, and 6 poles
 - 4. Non-Fusible and Fusible

DISCONNECT SWITCHES

5. Copper/aluminum standard mechanical lugs.

B. Construction

1. Switchblades and jaws shall be plated copper.
2. Switches shall have a handle that is easily pad lockable in the OFF position.
3. Switches shall have defeat-able door interlocks that prevent the door from opening when the handle is in the ON position.
4. Switch assembly and operating handle shall be an integral part of the enclosure base.
5. Fusible switches rated 100A to 1200A shall have reinforced fuse chips.
6. Switch blades shall be readily visible in the OFF position
7. Switch operating mechanism shall be non-teasible, positive quick-make/quick-break type (except 30A plug fuse-type)
8. Fusible switches shall be suitable for service entrance equipment.
9. Switches shall have line terminal shields.
10. All exterior switches shall be heavy-duty type.
11. All interior switches shall be general-duty type unless otherwise noted.

C. Enclosers

1. Exterior: All enclosures shall be NEMA 3R rainproof unless otherwise noted.
2. Interior: All enclosures shall be NEMA 1 unless otherwise noted.

D. Fuses

1. Fuses shall be dual element, current limiting type such as Bussmann Low-Peak Yellow or equal.

2.04 NAMEPLATES

- A. Manufacturers nameplates shall be front cover mounted, contain a permanent record of switch type, ampere rating, and maximum voltage rating.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. All switches shall be cleaned free of debris after installation and prior to final acceptance by the owner. Remove all miscellaneous paint markings, grease and tar.

3.02 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

3.03 INSTALLATION

- A. The equipment shall be installed per the manufacturer's recommendations.

END OF SECTION 26 44 10

SECTION 26 51 00 - LUMINAIRES

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Lighting fixtures
2. Lamps
3. Ballasts
4. Emergency lighting units

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. C78 Series Lamps
2. C82.1-97 Electric Lamp Ballast - Line Frequency Fluorescent Lamp Ballast
3. C82.2-84 Fluorescent Lamp Ballasts - Methods of Measurements
4. C82.4-92 Ballasts for High Intensity Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type)
5. C82.11-93 High Frequency Fluorescent Lamp Ballasts

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.11-93 IEEE Recommended Practice on Metal Oxide Surge Arresters for Alternating Current Power Circuits

C. National Fire Protection Association (NFPA):

1. 70 National Electrical Code

D. Underwriters Laboratories Inc. (UL):

1. 844-95 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
2. 924-95 Emergency Lighting and Power Equipment
3. 935-95 Fluorescent Lamp Ballast
4. 1029-94 High Intensity Discharge Lamp Ballasts
5. 1570-95 Fluorescent Lighting Fixtures
6. 1571-95 Incandescent Lighting Fixtures
7. 1572-97 High Intensity Discharge Lighting Fixtures

1.03 DEFINITIONS:

- A. Emergency Lighting Unit: Fixture with integral emergency battery power supply and means for controlling and charging battery. Emergency units are available with integral lamps only.
- B. Fixture: Complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply. Internal battery powered exit signs and emergency lighting units also include battery and means for controlling and recharging battery. Emergency lighting units are available with and without integral lamp heads and lamps.
- C. Luminaire: Fixture.
- D. Average Life: Time after which 50% will have failed and 50% will have survived under normal conditions.
- E. Total Harmonic Distortion (THD): The root mean square (RMS) of all the harmonic current components divided by total fundamental (60 hz) current.

1.04 SUBMITTALS:

- A. Procedures: Submit in accordance with Section 01300, 16010, and as stated herein.
- B. Product Data:
 - 1. Describe fixtures, lamps, ballasts, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories and the following information:
 - a. Outline drawings of fixtures indicating dimensions and principal features.
 - b. Electrical ratings and photometric data with specified lamps and certified results of independent laboratory tests.
 - c. Data on batteries and chargers of emergency lighting units.
- C. Shop Drawings:
 - 1. Detail nonstandard fixtures indicating dimensions, weights, methods of field assembly, components, features, and accessories.
- D. Supplies:
 - 1. Submit sample of fixture if different than specified.
- E. Miscellaneous:
 - 1. Warranty for rechargeable battery.
 - 2. Coordination drawings for fixtures that require coordination with other equipment installed in the same space.

F. Substitutions to Specified Product

1. Prior approval requests will include the following :
 - a. Full submittal data, by type, clearly highlighted and arrowed to identify the specific proposed manufacturer's nomenclature
 - b. Full submittal data of lamps of proposed manufacturer
 - c. Full submittal data of ballast/driver (LED) data of proposed manufacturer
 - d. LED lumen data shall include:
 - i. Lumen output
 - ii. L70 and L90 testing
 - iii. Confirmation of independent test lab data ITL
 - iv. Color temperature and CRI with quantity of McAdam Ellipse steps
 - v. Data shall include sphere and goniometer results for total lumen, total power, luminaire efficacy, CRI and junction temperature for the specified color temperature
 - vi. Make and brand of LED diode should be clearly identified on submittal data
 - vii. LED dimming shall be equal in range and quality to the specified drivers, Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.
 - viii. All substitutions must meet specified fixtures certifications (UL,ETL,CE,CSA,RoHS,DLC, Energy Star)
2. Provide lighting calculations with the prior approval request based on reflectance values and light loss factors provided by the engineer and displayed on lighting calculation drawings. (may be unique by area)
Calculations shall be shown on one sheet with dimensions as shown on construction set. Data will be submitted electronically in dxf format on a flash drive and with printed calculations on Architectural E size sheets to scale with construction set sheets.
 - a. Discrepancies between prior approval data calculations and the original design calculations will result in immediate disqualification of review due to time based constraints on the bid process
3. Prior approval request may require a sample of both the proposed and specified fixtures provided by the alternate manufacturer at NO additional cost to the project. Samples of both specified and proposed must be provided within 10 working days of request.
4. Energy calculations (Comcheck) must be provided with specification sheets including lamp and ballast data supporting input wattages highlighted in yellow and clearly identified by type. Input voltages must coincide with panel schedules. This data will be submitted under separate cover with the prior approval request
5. All data will be submitted electronically and in a bound format

- a. Bound data will be secured in hard binder with 3" rings for ease of review.
 - b. Types will be marked with a tab by type and indexed for ease of reference
6. LED warranty information MUST be included by type and marked in RED to clearly identify the manufacturer's warranty terms. Warranty data MUST meet or exceed the specified manufacturers terms
7. Prior approvals MUST be received and acknowledged to the specifiers office no less than 15 days prior to bid.
8. ALL prior approval data must be submitted in one package with complete information. Information that is incomplete will be rejected without review.
9. The prior approval will be returned marked approved or rejected by type with no explanation. If any specification is deemed not equal the review will be stopped and the type rejected with no explanation.
10. Lumen output for the proposed fixture must be highlighted in yellow for clear identification
11. All inverter systems that supply power to LED fixtures must have pure PWM sine wave function and work with any type of lighting load.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.
- B. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat and blocked off ground.
- C. Handle lighting fixtures carefully to prevent damage, breaking, and scarring of finishes. Do not install damaged units or components; replace with new.

1.06 QUALITY ASSURANCE:

- A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).
 1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
 2. Terms "listed and "labeled" shall be as defined in National Electrical Code, Article 100.
- B. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.
- C. Coordinate fixtures mounting hardware and trim with ceiling system.

PART 2 - PRODUCTS

2.01 FIXTURES, GENERAL:

- A. Comply with requirements specified in Paragraphs below and lighting fixture schedule.

2.02 FIXTURE COMPONENTS, GENERAL:

- A. Metal Parts: Free from burrs, sharp corners and edges.
- B. Sheet Metal Components: Steel, except as indicated. Form and support components to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
1. White Surfaces: 85%
 2. Specular Surfaces: 83%
 3. Diffusing Specular Surfaces: 75%
 4. Laminated Silver Metallized Film: 90%
- E. Lenses, Diffusers, Covers, and Globes: 100% virgin acrylic plastic or water white, annealed crystal glass except as indicated.
1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 2. Lens Thickness: 0.125 inch, minimum.

2.03 SUSPENDED FIXTURE SUPPORT COMPONENTS:

- A. Single-Stem Hangers: ½-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, ½-inch steel tubes with single canopy arranged to mount single fixture. Finish same as fixture.
- C. Rod Hangers: ¼-inch diameter cadmium plated, threaded steel rod.

- D. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.

2.04 LED LIGHTING FIXTURES AND LED LAMPS

- A. All LED products must be UL, ETL and/or CSA listed
- B. All LED products must have LM-79 and LM-80 testing noted on specification sheet by an independent test lab
 - 1. See note P this section
- C. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data
- D. All outdoor pole mounted products must have surge suppression within each fixture.
 - 1. See note P this section
- E. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data
- F. All LED products must be serviceable for accessible for field repair needs
- G. All outdoor lighting color rendering should be within a 7 step McAdams Ellipse. All outdoor lighting should be 4000 kelvin unless specifically noted
 - 1. See note P this section
- H. All indoor lighting color rendering should be within a 3 step McAdams ellipse. All indoor lighting should be 4000-4100 kelvin unless specifically noted
 - 1. See note P this section
- I. All control systems that interface with an LED product will be supported by a project “integrator” until project completion. This includes contact with the installer prior to installation, availability during installation, and final checkout and startup after installation. The quantity of days required for startup will be based on the manufacturer/agents discretion and need.

1. The project integrator must be capable of performing low voltage and dmx terminations. High voltage terminations are performed solely by the electrical subcontractor.
 2. Reporting of final startup completion of the controls system back to the engineer is mandatory.
- J. Invitation to attend the training with the owners representative should be made to the engineer no less than 5 days prior to training
- K. Signature confirmation of training and startup is required within 5 business days after completion back to the engineers office.
1. A follow up call will be made to the owner 30-45 days after the startup and training of the controls system by the manufacturers representative to ensure all systems are operating to design specification. A 3 hour onsite system fine tuning at no additional cost to the owner is inclusive if requested by the owner at that time for additional training and programming.
- L. All LED drivers should be capable of 0-10 volt controls and DMX control and shall dim to 1% of total lumen output . Where specifically specified the dimming driver may be required to dim to .1% of lumen output , otherwise known as “dim to dark”
- M. Driver manufacturers must have a 5 year history producing dimmable electronic LED drivers for the North American market.
- N. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F)
- O. Driver must limit inrush current.
1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amp per 10 amps load with a maximum of 370 amps/2 seconds
 2. Preferred specification : Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
 3. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A
 4. No visible change in light output with a variation of plus/minus 10% line voltage input.
 5. Total harmonic distortion less than 20%, and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD
 6. See note P this section.
- P. Any exceptions are at the engineers discretion based on project needs and applicability.

2.05 FLUORESCENT FIXTURES:

- A. Fixtures: Conform to UL 1570.
- B. Ballasts: Electronic type. Conform to UL 935, ANSI C82.11 and NFPA 70.
 - 1. Certification: By Electrical Testing Laboratory (ETL).
 - 2. Labeling: By Certified Ballast Manufacturers Association (CBM).
 - 3. Type: Class P, 0.95 P.F. minimum.
 - 4. Sound Rating: "A" rating, except as indicated otherwise.
 - 5. Voltage: Match connected circuits.
 - 6. Temperature: Start and operate at minimum of 50° F.
 - 7. THD: 10 percent maximum.
- C. Low Temperature Ballast: Start and maintain operation at a minimum of 0° F.
- D. T-8 Lamp Ballasts: Full-light output type, compatible with energy-saving lamps. Following are required average input wattages when tested according to ANSI C82.2.
 - 1. 39 or less when operating one F32T8 lamp.
 - 2. 62 or less when operating two F32T8 lamps.
 - 3. 95 or less when operating three F32T8 lamps.
 - 4. 114 or less when operating four F32T8 lamps.
- E. Recessed fluorescent fixtures shall have 100% acrylic prismatic lenses with a minimum thickness of 0.125 inch unless otherwise indicated.

2.06 HIGH INTENSITY DISCHARGE (HID) FIXTURES:

- A. Fixtures: Conform to UL 1572.
- B. Ballasts: Conform to UL 1029 and ANSI C82.4. Provide ballasts with following features, except as otherwise indicated.
 - 1. Constant wattage autotransformer (CWA) or regulator, high-power-factor type.
 - 2. Voltage rating matches system voltage.
 - 3. Single-Lamp Ballasts: Minimum starting temperature of -30° C.
 - 4. Normal ambient operating temperature is 40° C.
 - 5. Open circuit operation will not reduce average life.
 - 6. Noise Suppression: Manufacturer's standard epoxy encapsulated model designed to minimize audible fixture noise.

2.07 INCANDESCENT FIXTURES:

LUMINAIRES

- A. Conform to UL 1571.

2.08 FIXTURES FOR HAZARDOUS LOCATIONS:

- A. Conform to UL 844 or provide units that have Factory Mutual Engineering and Research Corporation (FM) certification for indicated class and division of hazard.

2.09 EXIT SIGNS:

- A. Conform to UL 924.
 - 1. Sign Colors: Conform to local code.
- B. Self-Powered Exit Signs (Battery Backup): Integral automatic high/low trickle charger in self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel cadmium type 1.5 hour minimum emergency run time.

2.09 EMERGENCY LIGHTING UNITS:

- A. Conform to UL 924. Provide self-contained units with features and characteristics as indicated on the drawings.

2.10 LAMPS:

- A. Conform to ANSI C78 series applicable to each type of lamp.
- B. Fluorescent Lamps: Color temperature of 3500⁰ K.

2.11 FINISH:

- A. Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.
- B. Other Parts: Manufacturer's standard finish.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Set units plumb, square and level with ceiling and walls, in alignment with adjacent fixtures, and secure according to manufacturer's printed instructions and approved submittals.
- B. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to the center of fixture for wall-mounted fixtures.
- C. Obtain approval of the exact mounting for lighting fixtures on the job prior to commencing installation and, where applicable, after coordinating with the type, style and pattern of ceiling being installed.
- D. Where recessed fixtures are supported by ceiling support grid, install additional support wires near each corner of the fixture.
- E. Make branch circuit wiring connections with conductors having an insulation temperature rating suitable for the fixture.
- F. Ground and bond fixtures in accordance with Section 16060.
- G. Install lamp units according to manufacturer's instructions and fixture schedule.

3.02 FIELD QUALITY CONTROL:

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Give 7-days notice of dates and times for field tests.
- C. Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source.
- D. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation.
 - 1. Duration of supply.
 - 2. Low battery voltage shut-down.
 - 3. Normal transfer to battery source and retransfer to normal.
 - 4. Low supply voltage transfer.
- E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.03 ADJUSTING AND CLEANING:

- A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.
- C. Set and adjust photocells and/or time switches for proper operation as directed by Owner.

3.04 PRE-CONSTRUCTION JOBSITE VISIT:

- A. Pre-construction On-site Services to be provided by Lighting/Controls vendor/supplier:

The project electrical contractor shall contact Lighting vendor/supplier to schedule a jobsite meeting prior to the installation of the lighting control system. Purpose of the meeting is to review submittals and installation documentation provided by the system manufacturer. Discussion should include wiring conventions and specific wiring requirements. Installation of specific devices is also to be addressed.

Prior to start-up Lighting manufactures representative shall send a field service technician to visit the jobsite to confirm progress and answer any additional questions. Start-up date is to be confirmed at the time of this visit. Training agenda shall be provided to the contractor/distributor. Contractor/distributor shall confirm with the owner's representative and specifying engineer attendance at lighting system demonstrations and for training. Contractor/distributor shall provide to field service technician programming information as required for start-up such as but not limited to zone assignments, time schedules for operation, presets for all control stations, programming sequences for dynamic LED fixtures, emergency operation, blink-warn, and system override. Programming information is required for system set-up and pre-start-up.

- B. Lighting Control System Start-up and Training

- 1. Prior to energizing lighting control system the following must be completed:

No component of the lighting control system shall be energized until a factory certified field service engineer has approved the installation of the system by the project electrical contractor. The electrical contractor/distributor shall contact the Lighting vendor/supplier at least 3 weeks prior to the requested start-up date to schedule a field service technician to be at the jobsite. Request shall be in writing and shall include filled out start-up request form and dated jobsite photos of the dimmer and/or relay panels.

Lighting Control system is defined as the dimmer/relay panel(s) and all associated control stations and related accessories.

The electrical contractor is responsible to install the entire lighting control system, all power feeders, all load wiring, and control wiring. Equipment shall be installed according to the manufacturer's instructions, contract documents, and national and local codes and regulations.

Equipment shall be plumb and level to the finished floor. All components of the lighting

control system shall be clean, free of dust and paint spatters. Components shall be unmarred or damaged. All cable shall be dressed, neatly routed, and labeled. All conduit shall be securely attached to the dimmer/relay panel.

Start-up services are not provided in conjunction or in association with any commissioning of lighting or other related control systems.

2. System Start-up

Each dimmer/relay shall be tested by the electrical contractor (with a multi-meter) to confirm what voltage is being passed and to confirm that no voltage is being passed when the circuit is open.

A representative of the owner shall be present to observe the testing/demonstration of the dimmer/relay panels. Each individual dimmer/relay panel shall be load tested with all circuits on while under load for a minimum of 1 hour.

Where external devices are to be attached to the dimmer/relay panel including photocell, occupancy sensor, time clock, DMX controller, and/or control stations, operation of each device should be verified at the panel and specific circuits that are programmed to be controlled by the external device(s).

Where control signals originate from the dimmer/relay panel for control of lighting fixtures, the control signal shall be tested by the electrical contractor to confirm that it is being delivered to each lighting fixture. Proper operation of the lighting fixtures shall be confirmed as part of the system testing/demonstration.

3. Training

Training shall be provided for the owner's representative and contractor. Prior to start-up the owner's representative and electrical contractor/distributor shall acknowledge receipt of training agenda. The electrical contractor/distributor shall confirm that the specifying engineer has been contacted and been invited to attend the system demonstration and/or training. All product and lighting control system documentation and operation's manuals shall be provided by electrical contractor/distributor at the time of training.

Training is to include, but not be limited to: basic operation of lighting control system, set-up of system and control panels, operation of control stations, programming of system, basic de-bugging, and overall system testing. At completion of training session all attendees shall sign the start-up technician's field service report to confirm participation in the training session.

Completed field service report shall be submitted to the electrical contractor/distributor and specifying engineer.

3.05 FOLLOW-UP CONTACT SERVICES

Approximately 90 days following the initialization of the lighting control system the Lighting/controls vendor/supplier shall contact the electrical contractor/distributor to confirm

that the system is operating correctly and answer any questions that have come-up since system initialization.

3.06 EXTENDED FOLLOW-UP CONTACT ON-SITE SERVICES

Approximately 300 days following initialization of the lighting control system the Lighting/controls vendor/supplier shall contact the owner's representative in order to schedule a job site visit. The purpose of the visit shall be to confirm that all lighting control equipment that was initialized by lighting/control vendor/supplier is fully functioning. Any equipment not functioning as originally specified shall be repaired as required.

In addition if the end user has adjustments that need to be made to programming or to any of the control of the system these shall be made during the jobsite visit. If further training on the system is required this shall be provided at the time of the visit or scheduled at a time of mutual convenience.

A completed field service report shall be submitted to the electrical contractor, specifying engineer, and the owner's representative.

END OF SECTION 26 51 00

SECTION 26 74 00 - TELEPHONE/DATA SYSTEMS (ROUGH-IN)

PART 1 – GENERAL

1.01 GENERAL

- A. Applicable provisions of the General Conditions, Supplemental General Conditions and Special Conditions govern work under this Section.

1.02 DESCRIPTION OF WORK

- A. This section includes work required to provide a system of raceways, outlet boxes with covers, terminal boards, and grounding to accommodate the installation of the telephone/data cabling system by Owner/Owner's vendor. Note that some indicated ceilings are inaccessible and extensions of raceways to accessible ceiling areas will be required.

1.03 RELATED SECTIONS

- A. Division 26 – ELECTRICAL

1.04 REFERENCES

- A. National Electrical Code (NEC)

1.05 SYSTEM DESCRIPTION

- A. It is the intent of this Specification to provide a system of raceways and outlets to accommodate the installation of telephone and data cabling by the Owner's vendor under a separate contract. The Contract Documents indicate the location and size of the main telephone service raceway and the location of telephone/data outlets and terminal boards. Routing of raceway system between outlets and terminal points shall be determined in the field by the contractor. Design of the system is based upon the premise that the telephone/data system installer will provide UL listed low smoke producing plenum cabling conforming to NEC requirements, permitting open wiring in plenum areas above accessible ceilings.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Raceways: All raceways shall be furnished and installed in accordance with the requirements of this Section and Section 261360.

- B. Outlet Cover Plates: All outlet coverplates shall be in accordance with the requirements of Section 261400. Provide for unused outlet boxes.
- C. Terminal Boards: Terminal boards shall be ¾-inch type Marine grade plywood having two coats of insulating oil base exterior enamel paint applied before installation on both sides and all edges. The quantity and dimensions shall be as indicated on the drawings.
- D. Cabling: By Owner's vendor under separate contract.
- E. Jacks: By Owner's vendor under separate contract.

PART 3 – EXECUTION

3.01 CONSTRUCTION

- A. Install terminal boards straight and level at locations indicated on drawings. Attach to masonry walls using expansion anchors, to CMU walls using toggle bolts, and to sheetrock and plaster walls using wood or sheet metal lag bolts fastened into the wall supporting the structure. The use of toggle bolts in sheetrock and plaster walls is not acceptable. Install anchors at a maximum of 24-inches on center at the perimeter of each board.
- B. At the main terminal board, stub-up the service entrance conduits at one end of the board within 3 inches of the supporting wall.
- C. Service entrance conduits shall be rigid galvanized steel or PVC encased in concrete with steel reinforced where it passes through the foundation and for at least 5' beyond the building line.
- D. Unless otherwise indicated, distribution raceways shall be electrical metallic tubing, except the PVC Schedule 40 may be used where raceway is buried in concrete slabs, columns, or beams. Provide insulating bushings at the ends of all raceways.
- E. The conduit size for each outlet shall be 1-1/4 inch minimum.
- F. Boxes shall be steel having the minimum dimensions of 4-11/16"x4-11/16"x2-1/8".
- G. Provide conduit from each outlet location to an accessible location above a lay-in type ceiling. Terminate conduit with bushing.
- H. Provide raceways sufficient to accommodate telephone cabling where passing through mechanical and electrical equipment rooms, pipe chases, mechanical chases, areas without ceilings (exposed structure), and nonaccessible areas such as ceiling plenums and crawl spaces.
- I. Provide ¾-inch conduit with #6 AWG bare copper ground wire from main terminal location and bond to building grounding system as indicated on drawings.
- J. Contact local telephone company to coordinate the exact telephone service entrance location and requirements prior to installing the telephone service raceways.

K. Refer to construction drawings for additional requirements.

END OF SECTION 26 74 00

SECTION 26 75 00 - CABLE TELEVISION SYSTEM (ROUGH-IN)

PART 1 – GENERAL

1.01 GENERAL

- A. Applicable provisions of the General Conditions, Supplemental General Conditions and Special Conditions govern work under this Section.

1.02 DESCRIPTION OF WORK

- A. This section includes work required to provide a system of raceways, outlet boxes and grounding of a cable TV system. Note that some indicated ceilings are inaccessible and extensions of raceways to accessible ceiling areas will be required.

1.03 RELATED SECTIONS

- A. Division 26 – ELECTRICAL

1.04 REFERENCES

- A. National Electrical Code (NEC)

1.05 SYSTEM DESCRIPTION

- A. It is the intent of this Specification to provide a system of raceways, outlet boxes and grounding to accommodate a CATV system by the Owner's vendor under a separate contract. The Contract Documents indicate the location and size of the main Cable service raceway and the location of TV outlets. Routing of raceway system between outlets and terminal points shall be determined in the field by the contractor. Design of the system is based upon the premise that the cable TV system installer will provide UL listed low smoke producing plenum cabling conforming to NEC requirements, permitting open wiring in plenum areas above accessible ceilings.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Raceways: All raceways shall be furnished and installed in accordance with the requirements of this Section and Section 261360.
- B. Outlet Cover Plates: Provide outlet cover plates in accordance with the requirements of Section

261400. Provide where outlet boxes are unused.

PART 3 – EXECUTION

3.01 CONSTRUCTION

- A. Install terminal boards straight and level at locations indicated on drawings. Attach to masonry walls using expansion anchors, to CMU walls using toggle bolts, and to sheetrock and plaster walls using wood or sheet metal lag bolts fastened into the wall supporting the structure. The use of toggle bolts in sheetrock and plaster walls is not acceptable. Install anchors at a maximum of 24-inches on center at the perimeter of each board.
- B. At the main terminal board, stub-up the service entrance conduits at one end of the board within 3 inches of the supporting wall.
- C. Unless otherwise indicated, distribution raceways shall be electrical metallic tubing, except the PVC Schedule 40 may be used where raceway is buried in concrete slabs, columns, or beams. Provide insulating bushings at the ends of all raceways.
- D. The conduit size for each outlet shall be 3/4-inch minimum.
- E. Boxes shall be steel having the minimum dimensions of 4-11/16"x4-11/16"x2-1/8".
- F. Provide conduit from each outlet location to an accessible location above a lay-in type ceiling. Terminate conduit with bushing.
- G. Provide raceways sufficient to accommodate cabling where passing through mechanical and electrical equipment rooms, pipe chases, mechanical chases, areas without ceilings (exposed structure), and non-accessible areas such as ceiling plenums and crawl spaces.
- H. Provide 3/4-inch conduit with #6 AWG bare copper ground wire from main terminal location and bond to building grounding system as indicated on drawings.
- I. Provide pull wire or mylar cord in any empty conduit.
- J. Coordinate final termination with the Architect, Owner's representative and the Local Cable TV provider.

END OF SECTION 26 75 00

SECTION 27 05 26 – GROUNDING AND BONDING FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section governs the products and execution requirements relating to furnishing and installing grounding and bonding for the communication systems.
- B. Description of work:
 - 1. Furnish and install a complete and fully-functioning grounding and bonding system. All cables, terminations, support hardware, and grounding and bonding hardware shall be furnished, installed, tested, labeled, and documented by the telecommunications subcontractor.
 - a. Coordinate with electrical contractor including pathways, termination points, busbar locations and connections to the main electrical service ground and electrical distribution panels.

1.2 RELATED DOCUMENTS

- A. The most recent versions of all related documents apply to this project.
- B. The following codes shall be followed as required by law:
 - 1. National Electric Code (NEC)
- C. The following standards shall be followed:
 - 1. IEEE Std 1100 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment (Emerald Book)
 - 2. ANSI/NECA/BICSI--607 - Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 - 3. ANSI/TIA--607-B - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - 4. ANSI/TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure
- D. The following guidelines shall be followed:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
- E. The following related project specifications shall be followed:
 - 1. 27 05 53 Identification for Communications Systems

1.3 DEFINITIONS AND ACRONYMS

- A. BCT – Bonding Conductor for Telecommunications -- A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground.
- B. Bonding – The joining of metallic parts to form an electrically conductive path
- C. GE – Grounding Equilizer -- The conductor that interconnects elements of the telecommunications grounding infrastructure.
- D. Ground – A conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.
- E. NRTL – Nationally Recognized Testing Laboratory
- F. RBC – Rack Bonding Conductor -- A bonding conductor used to connect an equipment rack directly to the TMGB, or TGB.
- G. RGB – Rack Grounding Busbar -- A busbar that is vertically mounted on an equipment rack.
- H. TBB – Telecommunications Bonding Backbone -- A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar
- I. TGB – Telecommunications Grounding Busbar -- A common point of connection for telecommunications system and equipment bonding to ground, and located in the telecommunications room or equipment room.
- J. TMGB – Telecommunications Main Grounding Busbar -- A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.
- K. UBC – Unit Bonding Conductor -- A conductor that interconnects the Rack Bonding Busbar to the telecommunications equipment.

1.4 SUBMITTALS – NOT USED

PART 2 - PRODUCTS

2.1 GENERAL

- A. All components shall be Listed by a NRTL.

2.2 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- A. A telecommunications main grounding busbar (TMGB) shall be provided and installed at the telecommunications service entrance (or as indicated on the drawings).
- B. The TMGB shall:
 - 1. Be a predrilled copper busbar with holes for use with correctly matched Listed lugs and hardware.

2. Have minimum dimensions of 0.25" thick by 4" wide by 16" long. Increase length as necessary to provide all connections plus 25% spare capacity.
3. Be Listed by a NRTL.
4. Be manufactured by:
 - a. Chatsworth
 - b. Erico
 - c. Harger
 - d. Hoffman
 - e. Panduit
 - f. Or approved equivalent

2.3 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- A. A telecommunications grounding busbar (TGB) shall be provided and installed in each telecommunications room.
- B. The TGB shall:
 1. Be a predrilled copper busbar with holes for use with correctly matched Listed lugs and hardware.
 2. Have minimum dimensions of 0.25" thick by 2" wide by 12" long. Increase length as necessary to provide all connections plus 25% spare capacity.
 3. Be listed by a NRTL.
 4. Be manufactured by:
 - a. Chatsworth
 - b. Erico
 - c. Harger
 - d. Hoffman
 - e. Panduit
 - f. Or approved equivalent

2.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

- A. A BCT shall:
 1. Be copper and may be insulated.
 2. Be Listed for the application when insulated.
 3. As a minimum, the same size as the largest TBB.
- B. The manufacturer shall be:
 1. Harger
 2. Or approved equivalent

2.5 TELECOMMUNICATIONS BONDING BUSBAR (TBB)

- A. The TBB shall:
 - 1. Be copper and may be insulated.
 - 2. Be Listed for the application when insulated.
 - 3. Be sized at 2 kcmil per linear foot of conductor length up to a maximum size of No. 3/0 AWG.

2.6 GROUNDING EQUILIZER (GE)

- A. A GE shall:
 - 1. Be copper and may be insulated.
 - 2. Be Listed for the application when insulated.
 - 3. As a minimum, the same size as the largest TBB.
- B. The manufacturer shall be:
 - 1. Harger
 - 2. Or approved equivalent

2.7 RACK BONDING CONDUCTOR (RBC)

- A. An RBC shall:
 - 1. Be copper and may be insulated.
 - 2. Be Listed for the application when insulated.
 - 3. Be sized as a No. 6 AWG.
- B. The manufacturer shall be:
 - 1. Harger
 - 2. Or approved equivalent

2.8 RACK GROUNDING BUSBAR (RGB)

- A. Description: grounding Strip for 2-post and 4-post Communications Racks.
- B. A RGB shall:
 - 1. Be wrought copper and tin plated.
 - 2. Be capable of supporting multiple unit bonding conductors.
 - 3. Be Listed.
- C. The manufacturer shall be:

1. Harger
2. Panduit, Grounding Strip Kit, RGS134-1Y
3. Or approved equivalent

2.9 GENERAL BONDING CONDUCTORS OR JUMPERS

- A. Provide and install general bonding conductors and jumpers per construction documents. Refer to drawings and execution section for required locations.
- B. For all conductors and jumpers connecting equipment located in the same room as the TMGB/TGB, conductors/jumpers shall be in a green insulated jacket. This jacket shall include markings that indicate conductor size (minimum of #6 AWG), manufacturer, and UL listing.
- C. Manufacturer shall be:
 1. Harger
 2. Panduit
 3. Or approved equivalent

2.10 BONDING ACCESSORIES

- A. Grounding Lugs
 1. Shall be Listed for the application.
 2. Shall be two holes compression crimp with inspection window, unless otherwise noted.
 3. Copper or tin plated copper.
 4. Manufacturers shall be:
 - a. Erico, Cadweld Telecom Lugs
 - b. Harger
 - c. Panduit
 - d. Or approved equivalent
- B. Unit Bonding Conductor (UBC)
 1. Shall be Listed for the application.
 2. Shall be a minimum No. 12 AWG
 3. Copper with 90-degree bent lugs installed.
 4. Manufacturers shall be:
 - a. Erico, Cadweld Telecom Lugs
 - b. Harger
 - c. Panduit
 - d. Or approved equivalent

PART 3 - EXECUTION

3.1 GENERAL

- A. Locate TMGB and TGBs so that they are accessible to telecommunications personnel.
- B. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the Design Engineer in a timely fashion so as not to impact the construction timeline.
- C. At a minimum, provide exothermic welds as identified on the drawings or required in the specifications. For all other connections, irreversible compression connections are sufficient.
- D. Identification
 - 1. All telecommunications grounding and bonding conductors shall be labeled within 6" of each end. Labels shall be nonmetallic and read as follows:

IF THIS CONNECTOR OR
CABLE IS LOOSE OR MUST
BE REMOVED, PLEASE
CALL THE BUILDING
TELECOMMUNICATIONS
MANAGER

- E. Testing
 - 1. All grounding connections shall be tested for continuity and resistance after installation but prior to substantial completion. *The telecommunications contractor is to invite the Design Engineer and Owner's IT representative to witness a portion of this testing while it is being performed.*
 - 2. The test performed shall use an earth ground resistance tester that is configured for a continuity test otherwise known as a two-point test or a "dead earth" test. Tests shall be conducted between the electrical entrance ground and the TMGB as well as at each TGB. This resistance shall be less than 0.05 Ohms.

3.2 TMGB

- A. All metallic raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB.
- B. Insulate the TMGB 2" from the wall.
- C. For outside plant cables entering a building with a cable shield isolation gap, bond the cable shield (on the building side of the gap) to the TMGB. Outside plant protectors shall be bonded to the TMGB with a No. 6 AWG conductor.
- D. Connections to the busbar shall be made with 2-hole lugs.
- E. Connections shall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.3 TGB

- A. All metallic raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.
- B. Insulate the TGB 2" from the wall.
- C. Connections to the busbar shall be made with 2-hole lugs.
- D. Connections shall be made by cleaning the area of connection on the busbar and on the two-hole lug and then applying a thin coating of anti-oxidant compound.

3.4 BCT

- A. Route BCT in conduit from telecommunications service entrance room to the main electrical service ground connection.
 - 1. Label conduit at telecommunications service entrance with tag or adhesive label that states "Building Conductor for Telecommunications (BCT) to Main Electrical Service Ground Connection".
 - 2. Label conduit at main electrical service ground connection with tag or adhesive label that states "Building Conductor for Telecommunications (BCT) to Telecommunications Main Grounding Busbar (TMGB)".
 - 3. BCT shall not be run in a metallic conduit and shall not be completely encircled by metallic clamps.

3.5 TBB

- A. Where following the same routing as cable tray, attach TBB on the outer side of the cable tray to minimize contact with communications cabling.
- B. Size the TBB according to the following table:

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size AWG
Less than 4 (13)	6 (16mm ²)
4-6 (14-20)	4 (25mm ²)
6-8 (21-26)	3 (25mm ²)
8-10 (27-33)	2 (35mm ²)
10-13 (34-41)	1 (35mm ²)
13-16 (42-52)	1/0 (50mm ²)
16-20 (53-66)	2/0 (70mm ²)
Greater than 20 (66)	3/0 (95mm ²)

3.6 GENERAL BONDING CONDUCTORS OR JUMPERS

- A. General bonding conductors or jumpers are to be utilized in each telecommunications room between the TMGB/TGB and the following components:
 - 1. The communications building entrance protectors.

2. Electrical panel board (if in same room as TMGB/TGB).
3. Building steel (if available in same room as TMGB/TGB).
4. Telecommunications ladder rack and cable tray.
 - a. Bonding jumpers may be utilized to ground adjacent pieces of ladder rack and cable tray together, reducing the need to a single conductor back to the TMGB/TGB.
 - b. In cases where ladder rack or cable tray is painted, it is assumed that the paint will need to be removed at the connection point to ensure a completely bonded connection. If this is not the case, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.
5. Telecommunications equipment racks and cabinets.
 - a. Each cabinet and rack shall be bonded to the TMGB/TGB directly with a #6 AWG RBC from the Rack Grounding Busbar (RGB).
 - b. In cases where equipment racks or cabinets are painted, it is assumed that the paint will need to be removed at the connection point of the RGB to ensure a completely bonded connection. If this is not the case, submit documentation from manufacturer indicating NRTL testing was done in regards to grounding without removal of the paint.

3.7 GROUNDING LUGS

- A. Wires shall be inserted to the full depth of the lug.
- B. Space between wire insulation and the body of the compression lug shall be kept to a maximum of 1/4 inch.
- C. Lug must agree with wire size.
- D. To assure proper die is used with the specified connector, manufacturer's embossed coding systems shall be adhered to.
- E. Connectors shall not be modified in any way.
- F. Daisy chaining and stacking (piggy backing) of ground lugs is prohibited.
- G. Bolts, nuts, washers used to secure ground connections shall match the diameter of the hole.

END OF SECTION 27 05 26

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.02 SCOPE OF WORK

- A. This section includes the minimum requirements for communications cable pathway installations in the data center or common areas.
- B. Included in this section are the minimum composition requirements and installation methods for the following:
 - 1. nVent Caddy J-Hooks.

1.03 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA-568-D.0 – Generic Telecommunications Cabling for Customer Premises.
 - 2. ANSI/TIA-568-D.1 – Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA 568-D.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
 - 4. ANSI/TIA 568-D.3 – Optical Fiber Cabling Components Standard.
 - 5. ANSI/TIA-569-D – Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA-606-C – Administration Standard for Telecommunications Infrastructure.
 - 7. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

8. ANSI/TIA-862-B - Building Automation Systems Cabling Standard.
9. ANSI/TIA-942-B - Telecommunications Infrastructure Standard for Data Centers.
10. ISO/IEC 11801 - Generic Cabling for Customer Premises.
11. IEEE 802 Standards
 - a. IEEE 802.3af Power over Ethernet (PoE) Standard
 - b. IEEE 802.3at Power over Ethernet+ (Plus) Standard
 - c. IEEE 802.3an Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T
 - d. IEEE 802.3ba Media Access Control Parameter, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation
 - e. IEEE 802.11 Wireless Standard
12. NFPA 70 – National Electric Code, 2017

1.04 SUBMITTALS

- A. Provide product data for the following:
 1. Manufacturer's cut sheets, specifications and installation instructions for all products (submit with bid).

PART 2 - PRODUCTS

2.01 MAIN AND BRANCH PATHWAYS – J-HOOKS

- A. Subject to compliance with these specifications, HPNCCS shall be as manufactured by ERICO, Inc or approved equal.
 1. All pathways shall be designed with a cable fill capacity of 50% or less to allow for future growth.

2.02 REFERENCES

- A. ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- B. ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- C. ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled

- D. ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
- E. A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
- F. ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
- G. ASTM B117 Standard Method of Salt Spray (Fog) Testing
- H. ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
- I. ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.
- J. ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
- K. NFPA 70 National Electrical Code®

2.03 NON-CONTINUOUS CABLE SUPPORT (HPNCCS) SYSTEMS

A. HPNCCS

- 1. HPNCCS shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
- 2. HPNCCS shall have flared edges to prevent damage while installing cables.
- 3. HPNCCS shall have a cable retainer wire form to provide containment of cables within the hanger. The cable retainer shall be removable and reusable.
- 4. HPNCCS shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
- 5. Acceptable products: ERICO CADDY CAT16HP, CAT32HP, CAT48HP, CAT64HP

B. Multi-tiered HPNCCS assemblies:

- 1. Multi-tiered HPNCCS assemblies shall be used where separate cabling compartments are required. Assemblies may be created by joining the HPNCCS with snap-on tree-mounting brackets. Additional stability is achieved by bending the tabs of the HPNCCS. This completes assembly for wall installation. The assembly is rated for indoor use in non-corrosive environments; cULus Listed.
- 2. For installation on threaded rod, a snap-on angle bracket must be added on top of the assembly.

3. If required, the multi-tier HPNCCS assembly can be attached to snap-on angle or straight brackets riveted to beam clamps, flange clips, C and Z Purlin clips, etc.
4. Acceptable products: ERICO CADDY CAT16HP, CAT32HP, CAT48HP, CAT64HP and brackets CATHPAN, CATHPA4, CATHPA6, CATHPS4 and CATHPTM

2.04 FINISHES

- A. ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- B. ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

PART 3 – EXECUTION

3.01 INSTALLATION

A. J-Hooks

1. Installation and configuration shall conform to the requirements of the current revision levels of ANSI / EIA / TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
2. Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.
3. Install cables without damaging conductors, shield, or jacket.
4. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
5. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
6. Do not exceed load ratings specified by manufacturer.
7. Follow manufacturer's recommendations for allowable fill capacity for each size HPNCCS.
8. Support horizontal cables at a maximum of 48-inch (1.2 to 1.5-m) irregular intervals, if J-hook system is used to support cable bundles.
9. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits.
10. Bundle horizontal distribution cables in groups of no more than amount of cables designed for by cable support manufacturer, based on cable OD and weight.

END OF SECTION 27 05 28

SECTION 27 05 37 – FIRESTOPPING SYSTEMS FOR COMMUNICATIONS CABLING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This section shall govern the firestopping systems and installation as it relates to communications cabling. The intent of this section is to give the selection of an approved material and its installation by a qualified contractor.

1.2 RELATED DOCUMENTS

- A. The latest versions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from requirements in codes, standards, guidelines and specifications.
- B. The following codes, as required by law:
 - 1. National Electric Code (NEC)
 - 2. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.
- C. The following standards:
 - 1. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 - 2. ASTM E 84, "Surface Burning Characteristics of Building Materials".
 - 3. ASTM E 119, "Fire Tests of Building Construction and Materials".
 - 4. ASTM E 814, "Fire Tests of Penetration Firestop Systems".
 - 5. ANSI/UL263, "Fire Tests of Building Construction and Materials".
 - 6. ANSI/UL723, "Surface Burning Characteristics of Building Materials".
 - 7. ANSI/UL1479, "Fire Tests of Through Penetration Firestops".
 - 8. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)

1.3 QUALITY ASSURANCE:

- A. Provide firestopping systems that comply with the following requirements:
 - 1. Firestopping material shall be tested by a qualified testing and inspection agency. A qualified testing and inspection agency is UL, or another comparable agency performing testing (as approved by the Owner's IT representative).

2. Only Firestopping products bearing the classification marking of qualified testing and inspection agency shall be used.
- B. Installation craft persons / technicians shall be by qualified and trained. Acceptable Installer qualifications are as follows:
 1. FM Research approved in accordance with FM AS 4991.
 2. Individuals or staff who are certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training and experience. A minimum of 1 year experience in the installation of manufacturer's products is required.
 3. The Installers shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.4 DEFINITIONS:

- A. Communications cabling – including telecommunications, audio/video, coaxial, and distributed antenna systems.
- B. Conduit sleeve – a conduit that only penetrates a single wall for the purpose of providing a pathway for communications cabling into adjacent rooms.
- C. Firestop Assembly – a manufactured product from a reputable company that is delivered to the contractor fully- or partially-assembled and when installed is rated as meeting the UL 1479 or ASTM E814 standards for fire testing and becomes part of a Firestop System for that particular type of installation.
- D. Firestop System – a product or series of products from a reputable manufacturing company that when installed properly by the contractor meets the UL 1479 or ASTM E814 standards for fire testing for that particular type of installation.
- E. Zero maintenance firestop assembly – a firestop assembly with a self-contained sealing system which shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to adjust, remove or reinstall firestop material.

1.5 SUBMITTALS:

- A. Submit product data for review.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Communications cable tray or ladder rack shall not be continued through a fire-rated wall. Stop the tray or ladder rack, install multiple zero-maintenance firestop assemblies, and continue tray or ladder rack on the other side. Ensure grounding of the cable tray is continuous through the wall.
- B. Single Source: For all penetrations for communications openings through fire-rated walls and floors, install the same manufacturer's product for that type of penetration throughout the project.

C. Identification

1. At all firestop locations, install a label on each side of the wall indicating the following information:
 - a. Manufacturer of Firestop
 - b. Name of product and UL System Number
 - c. Name of installing contractor and date of installation.
 - d. Rating of the wall/system.

2.2 ZERO-MAINTENANCE FIRESTOP ASSEMBLY

- A. Shall meet or exceed the ratings of the wall or floor that it penetrates.
- B. Shall be used for communications cabling at all interior wall penetrations through a single, fire-rated wall or floor.
- C. Shall be a listed (UL and/or FM) firestopping assembly system tested to UL 1479 or ASTM E814. The assembly shall Assembly size and quantity shall be determined as follows:
 1. For round openings, fill ratio of cabling-to-opening-size shall not exceed 40%, or as dictated by the manufacturer, whichever is more stringent.
 2. For rectangular openings, fill ratio of cabling-to-opening size shall not exceed 50%, or as dictated by the manufacturer, whichever is more stringent.
 3. Include in cabling cross-sectional area enough spare capacity to accommodate 50% growth. Upon commissioning, if adequate spare capacity is not observed, contractor shall install additional assemblies at their own cost to provide such spare capacity.
- D. Manufacturer shall be:
 1. Specified Technologies Inc., EZ Path Series 22, 33, or 44.
 2. Or approved equivalent

2.3 FIRESTOPPING FOR COMMUNICATIONS CONDUITS & OTHER APPLICATIONS

- A. Required for all fire-rated wall penetrations where a communications pathway extends beyond a single fire-rated partition.
- B. Required for all telecommunications outlets located on fire-rated walls. System shall be UL CLIV tested.
- C. Shall be a listed (UL and/or FM) firestopping assembly system tested to UL 1479 or ASTM E814.
- D. Shall meet or exceed the ratings of the wall or floor that it penetrates. E. Manufacturer shall be:
 1. 3M – submit appropriate system and indicate on shop drawings where being utilized.
 2. Hilti - submit appropriate system and indicate on shop drawings where being utilized.

3. Specified Technologies Inc. - submit appropriate system and indicate on shop drawings where being utilized.

PART 3 - EXECUTION

3.1 GENERAL

- A. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- B. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- D. Do not use materials that contain flammable solvents.
- E. Coordinate construction of openings and penetrating items to ensure that through- penetration firestop systems are installed according to specified requirements.
- F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- G. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- H. Before beginning installation:
 1. Examine effected surfaces, as they shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
 2. Provide masking and temporary covering to protect adjacent surfaces.
 3. Do not proceed until unsatisfactory conditions have been corrected.
- I. Install through-penetration firestop systems in accordance with the conditions of testing and classification as specified in the published design. Comply with manufacturer's instructions for installation of firestopping products.
- J. After installation:
 1. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
 2. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

END OF SECTION 27 05 37

SECTION 27 05 53 – IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section shall govern the products and installation of identification and labeling of all required parts, pieces and accessories of the communications cabling system, which shall include, but is not limited to, cabling, faceplates, patch panels, 110-blocks, conduit, innerduct, junction and pullboxes, firestop locations, and the communications grounding system.
- B. Contractor shall also supply a cable manifest (spreadsheet) prior to construction for all backbone and horizontal cabling links, which shall identify the cable type, the starting and ending points of each cable, include pair/strand count, and indicate the label content on both ends (at the faceplate or telecommunications room termination). An updated cable manifest shall be delivered with substantial completion.

1.2 RELATED DOCUMENTS

- A. The latest versions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from requirements in codes, standards, guidelines and specifications.
- B. The following codes, as required by law:
 - 1. National Electric Code (NEC)
- C. The following standards:
 - 1. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)

1.3 QUALITY ASSURANCE:

- A. All labels shall be machine-printed, crisp, clear, non-smearing and extremely legible. Labels shall be durable for the life of the system (the 15+ year system warranty); labels which can be easily removed shall not be utilized.

1.4 DEFINITIONS:

- A. Uplink Cables – Where Communications Rooms are within 295 cabling feet of the Main Communications Room (MDF), they are to be connected back to the MDF by several Category 5e Uplink Cables. These act as backbone cables and should be treated as such.

1.5 COORDINATION WITH ITS ASSIGNMENT OFFICE:

- A. Prior to submission of pre-construction submittals, coordinate with the Owner's IT Representative for an owner-provided labeling scheme to be followed for each building.

1. ITS will provide a two (or three if applicable) digit designation for each Communication Room. Examples: 1A, 1B, 2A, 2B, etc.
 2. ITS will provide both copper and fiber backbone cable identifiers.
 3. Refer to the subsequent sections for additional instructions.
- B. Failure to coordinate with the Owner's IT representative on labeling and identification schemes in a timely manner, and/or failure to follow the requirements of this section may result in the project's Substantial Completion not being met.

1.6 SUBMITTALS

- A. The following submittals are due at the Pre-Construction Phase:

1. Product Information Submittals

- a. Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.
- b. For planned labeling for all outlets/horizontal cables and backbone cabling:
 - 1) Provide a complete list, in Microsoft Excel format, of the planned identification labels for all outlets/horizontal cables and backbone cables.
 - 2) Await approval or corrections by the Owner's IT representative for labeling scheme prior to printing/applying labels.

2. Shop Drawings

- a. Planned labeling for outlets:
 - 1) Provide scaled drawings of the floor plans showing all outlets with the proposed identification label for each outlet.
- b. Communication Rooms and Backbone Cabling:
 - 1) Provide a riser diagram that indicates each Communications Room by both room number and two letter ITS designation. Also indicate the ITS-provided backbone cable identifiers on this riser diagram, including Uplink Cables. The Owner's IT representative will provide specific labeling scheme using the Uplink Cable information provided.
- c. Planned labeling for racks and patch panels:
 - 1) Provide enlarged scaled drawings of each communication room indicating Rack Row and Number.
 - 2) Refer to the Execution section for additional information, including Rack Row/Number and Patch Panel labeling.

- B. The following submittals are due prior to Substantial Completion:

1. Record Drawings

- a. Updated shop drawings (now identified as Record Drawings) with any additions or changes as required during the course of construction.

2. Cable Manifest

- a. Provide cable manifest (spreadsheet) identifying source, destination, pair/strand count, and labeling scheme used for each horizontal and backbone cable.
- b. This file shall be readable with Microsoft Excel (2007 Version) with formatting intact.
- c. Submit this file on USB Flash Drive or CD/DVD-R specific for Div. 27 Record Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All labels or means of identification shall utilize machine-printed type.

2.2 HANDHELD LABELERS

- A. To be utilized for ISP cable labels, OSP (horizontal) cables, racks, and grounding busbars.
- B. Size according to cable diameter and readability.
- C. Shall be thermal-transfer type, and utilize self-adhesive labels.
- D. Approved manufacturers:
 1. Brady, IDXPRT
 2. Dymo, Rhino
 3. Hellermann Tyton, Spirit 2100
 4. Panduit, LS8E or LS9
 5. Or approved equivalent
- E. Alternatively, a thermal transfer desktop printer may be utilized with self-adhesive labels/rolls. Submit manufacturer and part number to be considered.

2.3 FACEPLACE, PATCH PANEL, AND WALL-BLOCK LABELS

- A. Faceplates, patch panels and wall-blocks shall have integral slots for label inserts. Have identification machine-printed onto label inserts and populate the integral slots with these inserts.
- B. Where intended-product does not have an integrated label insert, submit proposed labeling method.

2.4 GROUNDING AND BONDING CONDUCTORS

- A. Warning Marker
 1. Non-metallic, machine and pre-printed as a wrap-around marker (*not* a flag marker).
 2. Manufacturer shall be:
 - a. Panduit, LTYK
 - b. Or approved equivalent

B. Identification Label

1. Label shall be self-laminating, machine- and thermal-printed.
2. Size of label will vary with size of conductor:
 - a. For 18-14AWG, 1.00"x0.75" label
 - b. For 12-10AWG, 1.00"x1.25" label
 - c. For 8-4AWG, 1.00"x2.25" label
 - d. For 2-1AWG, 1.00"x4.00" label
 - e. For 1/0-250kcmil, 1.00"x6.50" label
3. Manufacturer shall be:
 - a. Panduit, S100X***VAC or S100X***VAT, where *** is the second dimension.
 - b. Equivalent from Brady or Hellermann Tyton
 - c. Or approved equivalent

PART 3 - EXECUTION**3.1 GENERAL**

- A. Install labels in such a way as to be physically and visually accessible.
- B. Remove any temporary labels and ensure no permanent labels are damaged during construction.
- C. Replace all damaged or missing permanent labels prior to substantial completion.

3.2 LABELING OF CABLING SYSTEMS**A. GENERAL**

1. Communications Room (Terminal Room) numbering is determined by the ITS Assignment Office. Coordinate with the Owner's IT Representative prior to submitting pre-construction shop drawings to obtain labeling scheme. Examples offered here are for preliminary purposes only. Final direction is to come from ITS during construction.
 - a. Example of numbering scheme:

NAME=FL/TR
SAC 0.102=BA
SAC 1.602 =1A
SAC 1.202 =1B
SAC 2.406=2A
SAC 2.202=2B
SAC 3.202=3B
SAC 4.102A=4A
SAC 5.110=5A
 - b. The first number/letter indicates the floor (Basement, 1st, 2nd, etc.); the second letter indicates the particular communications room on that floor (A, B, C, etc.) For buildings with more than 9 floors, each floor will have a leading zero (ex: 01, 09.10, 11, etc.)

2. Buildings that are part of (attached) to another may need the source building's three letter building code incorporated into the labeling scheme. Coordinate with the Owner's IT representative prior to submitting proposed labeling scheme to determine if the building suffix is needed.
- B. Equipment Racks
1. Racks in each communications room are to be labeled (minimum text height of 3/8").
 2. Racks are to be numbered left to right, from front of room to back.
 3. Label shall also include Terminal Room number before rack number.
 - a. Example "Rack 2A1", for Rack 1 in Terminal Room 2A.
 4. For any Communications Room with more than 9 racks, rack 1-9 must include '0' prefix.
 - a. Example "Rack 2A01" for Rack 1 of 11 in Terminal Room 2A.
- C. Patch Panels
1. Label the center of the patch panel with the PP# (ex: A-Z, top to bottom; skipping I and O). Each rack starts over with a new rack number and patch panel alpha labeling scheme from A-Z top to bottom (skipping I and O).
 - a. For patch panels exclusively serving wireless access points, add "WF" as a suffix.
- D. Terminations for Patch Panels and 110-blocks
1. Utilize available inserts: print with inkjet or laser printer.
 - a. Include full labeling scheme if size permits.
 - 1) Example: 1A1A01**
 - a) 1st floor
 - b) Terminal Room A (iii) Rack #1
 - c) Patch Panel A (v) Position #01
 - d) ** Add WF suffix for all outlets for wireless access points, FC for security video fixed camera, and PTZ for security video pan tilt zoom camera.
- E. Inside Plant (ISP) Horizontal Category Cable
1. Label within 6" at both termination ends.
 - a. Example: 1A1A01**
 - 1) 1st floor
 - 2) Terminal Room A
 - 3) Rack #1
 - 4) Patch Panel A
 - 5) Position #01
 - 6) ** Add WF suffix for all cables for wireless access points, FC for security video fixed camera, and PTZ for security video pan tilt zoom camera.

2. For cables routed through junction boxes and pull boxes, group all cables together by destination (room) via velcro-strap, and flag (identify) that destination near the velcro-strap.
- F. Outside Plant (OSP) Category Cable (horizontal cabling)
1. Label transition point (if utilized) as COMMUNICATIONS OSP TRANSITION POINT.
 2. Label all cables within transition point within 6” of termination ends.
 - a. Example: 1A1A01
 - 1) 1st floor
 - 2) Terminal Room A
 - 3) Rack #1
 - 4) Patch Panel A
 - 5) Position #01
- G. CATV (coaxial) cable labeling
1. Label within 6” at both termination ends and on faceplate.
 - a. Horizontal Cables:
 - 1) Format: 2-Digit ITS Comm Room Designation – Room # - Outlet # for that Room
 - 2) Example: 2B-3.208B-1
 - a) 2 = Floor number (will vary)
 - b) B = Terminal Room Identifier (will vary)
 - c) 3.208B indicate Room Number
 - d) 1 = indicates sequential CATV identifier for that room.
 - b. Backbone Cables:
 - 1) Format: CATV – Source Room (with 2-Digit ITS Designation) – Destination Room (with 2-Digit ITS Designation)
 - 2) Example: CATV – 2.212A (2A) – 3.412 (3A)
- H. Faceplates / Work Area Outlets
1. Utilize faceplate label inserts if available; print with inkjet or laser printer. Otherwise, use handheld printer with adhesive label for application directly onto faceplate. Labels are to have straight edges and alignment.
 - a. For Category 5e jacks
 - 1) Example: 1A1A01**
 - a) 1st floor
 - b) Terminal Room A
 - c) Rack #1
 - d) Patch Panel A
 - e) Position #01
 - b. For Category 6A jacks
 - 1) Example: 1A1A01**
 - a) 1st floor

- b) Terminal Room A
- c) Rack #1
- d) Patch Panel A
- e) Position #01
- f) ** Add WF suffix for all cables for wireless access points, FC for security video fixed camera, and PTZ for security video pan tilt zoom camera.

I. Copper Backbone (between Telecom Rooms)

1. Label within 6" at both ends of cable with the following information:

- a. ITS Designation – DESTINATION (TR#)
- b. Example: R2N – 3.336 (3A)

J. Fiber Backbone (between Telecom Rooms)

1. Cable - Label within 6" at both ends of cable with the following information:

- a. ITS Designation – STRANDS – DESTINATION (TR#)
- b. NAME shall follow the following format:
 - 1) OFMM### for multimode
 - 2) OFSM### for singlemode
 - 3) Coordinate with the Owner's IT representative for ### for fiber cables.
- c. Example: OFSM511 – STRANDS 1-12 – SZB 336 (3A)

3.3 PATHWAYS

A. Conduit

1. Label exterior of conduit as COMMUNICATIONS (unless otherwise noted on the drawings) with text readable from a standing position on the finished floor.
- a. For wall stub-up locations, label overhead only.
 - b. For strictly overhead conduits, label both ends.
 - c. For long runs of conduits that stub directly up or into Communications Room, label the end of the conduit in the Communications Room with the destination room number or location.
 - 1) Examples: FLOOR BOX ROOM 2.302, EMERGENCY CALL BOX NW CORNER OF BUILDING, ELEVATOR EQUIPMENT ROOM 1.402.
2. Sleeves which pass through a single wall or floor need not be labeled.

B. Junction boxes and pull boxes

1. Label exterior of junction boxes and pull boxes as COMMUNICATIONS with text readable from a standing position on the finished floor.
- a. Preferred method is to paint ITS on the lid in blue paint.

C. Firestop locations

1. All communications firestop locations are to be labeled on both sides of wall or floor. Refer to firestopping specification section for additional information.

3.4 GROUNDING

- A. Label TMGB as FLOOR# - ROOM# - TMGB.
- B. Label TGBs as FLOOR# - ROOM# - TGB.
- C. Label grounding conductors within 12” of both ends with Warning Marker and Identification Label.
 - 1. Identification label is to include the source and destination of the grounding conductor.

END OF SECTION 27 05 53

SECTION 27 08 20 – COPPER TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Test measurements shall be taken for all balanced-twisted pair cabling, including horizontal and backbone copper cables and wall-to-rack cables. Test all category cables in accordance with current TIA measurement specifications for that category of cabling with a field-test instrument meeting or exceeding Level IV accuracy. Provide test measurement results (in electronic format) a minimum of three weeks prior to substantial completion.

1.2 RELATED DOCUMENTS

- A. The latest versions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from requirements in codes, standards, guidelines and specifications.
- B. The following standards:
 - 1. ANSI/TIA-568-C.2 –Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - 2. ANSI/TIA-1152 – Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- C. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)

1.3 QUALITY ASSURANCE

- A. All testing procedures and field-test instruments shall comply with applicable requirements of:
 - 1. ANSI/TIA-568-C.2
 - 2. ANSI/TIA-1152
- B. Test measurements shall be performed by trained technicians who have successfully attended manufacturer training or BICSI Installer 2 copper training.
- C. The ITS Representative shall be invited to witness, review or both witness and review field-testing.
 - 1. Notify the ITS Representative and Design Engineer of the testing start date, five (5) business days before testing commences.
 - 2. After final test measurements have been completed and submitted, the ITS Representative or Design Engineer will select a random sample of up to 10% of the installed links that the telecommunications contractor is to retest at no cost to the Owner. If more than 2% of the sample results differ in terms of the pass/fail determination, the contractor, under

supervision of the ITS Representative, shall repeat 100% of the testing at no cost to the Owner.

1.4 SUBMITTALS

A. The following submittals are due at the Pre-Construction Phase:

1. Names of individuals that will be performing the testing and their training certificates (from BICSI or manufacturer).
2. Manufacturer's cutsheet or specifications sheet for the field-test instrument to be used, along with calibration data sheet.
3. Sample Test Report, which shall show that the field-test instrument software and firmware is up-to-date (the most recent version). This sample test report shall also show all required test parameters as required by the referenced standards.

B. The following submittals are due a minimum of three weeks prior to substantial completion:

1. Complete test measurement results indicating that all cable permanent links have passed.
 - a. Microsoft Excel 2007 (Manifest)
 - b. Electronic test measurement results in their native format and the manufacturer's PC software to read test results.

PART 2 - PRODUCTS

2.1 FIELD-TEST INSTRUMENT

A. The field-test instrument shall:

1. Be within the calibration period recommended by the manufacturer.
2. Contain the most recent software and firmware provided by the manufacturer prior to testing.
3. Be a Level IV accuracy (Or greater)

B. Administration

1. The test measurement result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
2. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

C. Manufacturer shall be:

1. Viavi
2. Fluke Networks
3. Or Approved equivalent

PART 3 - EXECUTION

3.1 GENERAL

- A. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any test measurements performed on incomplete systems shall be redone on completion of the work.
- B. The records for each cable test measurement shall be provided to the owner a minimum of three weeks prior to substantial completion in Excel format (manifest) and the native format to the field-test instrument.
- C. The installed twisted-pair links shall be tested from the telecommunications room to the telecommunication wall outlet in the work area for compliance with the “Permanent Link” performance specification.
- D. One hundred percent of the installed cabling links shall pass the requirements of the referenced standards. Any failing link shall be diagnosed and corrected. The corrective action shall be noted and followed with a new test measurement to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test measurements results documentation.
- E. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the test measurements. The field test instrument, including the appropriate interface adapter, shall meet Level IV accuracy requirements, as a minimum Level.
- F. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*. The “*” shall not be turned off on the test instrument.
- G. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field-test instrument manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification or agreed upon as a part of a contractual specification.

3.2 PERFORMANCE TEST PARAMETERS

- A. Not used

3.3 ADMINISTRATION

- A. Test results documentation
 - 1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”.

2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period. The contractor shall retain a copy to aid preparation of as-built information.
3. The records for each test shall be provided to the owner a minimum of three weeks prior to substantial completion in Excel format and the native format to the test instrument. The Owner can supply an Excel spreadsheet template upon request for the contractors use.
4. Circuit IDs reported by the field-test instrument shall match the label ID specified by the Owner.
5. The detailed test results documentation data is to be provided in an electronic database for each tested link and shall contain the following information
 - a. The identification of the customer site as specified by the end-user
 - b. The name of the standard selected to execute the stored test results
 - c. The name of the test personnel
 - d. The date and time the test results were saved in the memory of the tester
 - e. The manufacturer, model and serial number of the field-test instrument
 - f. The version of the test software and the version of the test standards database held within the test instrument
 - g. The copper identification number
 - h. The length for each copper cable
 - i. The overall Pass/Fail evaluation of the channel test.

END OF SECTION 27 08 20

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.02 SCOPE OF WORK

- A. This section includes the minimum requirements for the equipment and cable installations in communications equipment rooms (Telecommunications Closets).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
 - 1. 12U wall mount rack
 - 2. Vertical Cable Management
 - 3. Horizontal Cable Management
 - 4. Ladder Rack
 - 5. Bonding and Grounding

1.03 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturer's listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of:
 - 1. ANSI/TIA-568-D.0 – Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA-568-D.1 – Commercial Building Telecommunications Cabling Standard
 - 3. ANSI/TIA 568-D.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 - 4. ANSI/TIA 568-D.3 – Optical Fiber Cabling Components Standard

5. ANSI/TIA-569-D – Telecommunications Pathways and Spaces.
6. ANSI/TIA-606-C – Administration Standard for Telecommunications Infrastructure
7. ANSI/JSTD-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. ANSI/TIA-862-B - Building Automation Systems Cabling Standard
9. ANSI/TIA-942-B - Telecommunications Infrastructure Standard for Data Centers
10. ISO/IEC 11801 - Generic Cabling for Customer Premises
11. NFPA 70 – National Electric Code, 2017
12. NEMA – VE 1 – Metal Cable Tray Systems, 2017
13. NEMA – VE 2 – Metal Cable Tray Installation Guidelines, 2013

1.04 SUBMITTALS

- A. Provide product data for the following:
 1. Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

PART 2 - PRODUCTS

2.01 EQUIPMENT RACKS

- A. Wall-mount small rack enclosure:
 1. Design Make shall be:
Eaton TrippLite Series, 12U, low profile, wall mount, switch depth, hinged back

2.02 VERTICAL CABLE MANAGEMENT

- A. Vertical Cable Management for Racks/Frames
 1. Every rack/frame shall have two (2) vertical cable managers. The vertical cable manager shall create a space for storing and organizing cables along the side of the rack/frame. The cable manager shall maintain separation between patch/equipment/jumper cords and premise cables.
 2. The vertical cable manager shall match the height of the rack(s)/frame(s).
 3. The vertical cable manager shall bolt to the side of racks/frames with included hardware.
 4. Design Make shall be:

nVent Hoffman
Vertical Cable Manager

2.03 HORIZONTAL CABLE MANAGEMENT

A. Horizontal Cable Management for Racks/Frames

1. The horizontal cable manager shall guide patch/equipment cords between the vertical cable manager and individual network port connections.
2. The horizontal cable manager shall match the rack-mount width of the rack(s)/frame(s).
3. The horizontal cable manager shall attach to the front or rear of the rack/frame with screws and shall be sized to fit in standard EIA-310-D or EIA-310-E Universal rack-mount spacing (1-3/4" high U).
4. The horizontal cable manager shall be sized to match cabling requirements. Cables must be able to access the cable manager so that no ports are blocked by the cables.
5. Design Make shall be:

nVent Hoffman
Horizontal Cable Manager

2.04 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack

1. Design Make:
nVent Hoffman
Ladder Rack

- B. The cabling contractor shall provide and install all nVent Hoffman ladder rack, supports, and accessories to ensure a complete and functional system that is properly bonded and grounded.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Wall-Mount Small Rack Enclosure

1. Assemble and mount racks according to manufacturer's instructions.
2. Racks shall be grounded to the Telecommunications Grounding Busbar (TGB) using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority having jurisdiction.

3. Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack shall not be drilled to attach ladder rack. Use appropriate hardware from ladder rack manufacturer.

B. Vertical Cable Managers

1. Attach vertical cable managers to the side of the rack/frame using the manufacturer's installation instructions and included hardware.
2. When a single vertical cable manager is used in between two (2) racks/frames, attach the vertical cable manager to both racks/frames.
3. When more than one (1) cable manager is used on a rack/frame or group of racks/frames, use the same make, style and size of vertical cable manager on the rack/frame or in between racks/frames.
4. The color of the rack(s)/frame(s) and cable manager(s) must match.
5. Doors shall be attached to the cable manager and in the closed position after cabling is complete.

C. Horizontal Cable Managers

1. When more than one (1) horizontal cable manager is used in a rack/frame or group of racks/frames, use the same make and style of cable manager on the rack/frame or racks/frames.
2. The color of the rack(s)/frame(s) and cable manager(s) must match.
3. Attach horizontal cable managers to the rack/frame with four (4) screws according to the manufacturer's installation instructions. Each cable manager shall be centered within the allocated rack-mount space (U).
4. Horizontal managers shall be located so that the number of ports (cables) that each manager supports shall not exceed each cable manager's cable fill capacity.
5. Covers shall be attached to the cable manager and in the closed position after cabling is complete.

D. Ladder Rack

1. Provide all components of the ladder rack system (ladder rack, turns, splices, supports, and accessories) from a single manufacturer.
2. Ladder rack shall be installed with side stringers facing down so that the ladder forms an inverted U-shape and so that welds between the stringers (sides) and cross members (middle) face away from cables.
3. Ladder rack shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's

recommended supports and appropriate installation hardware and methods as defined by local code or the Authority having jurisdiction.

4. Ladder rack splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.
5. Ladder rack shall be supported every 5' (1.5 m) or less in accordance with TIA-569-B. Ladder rack shall be supported within 2' (0.6 m) of every splice and within 2' (0.6 m) on both/all sides of every intersection. Support ladder rack within 2' (0.6 m) on both sides of every change in elevation. Support ladder rack every 2' (0.6 m) when attached vertically to a wall.
6. Heavy-duty splices are recommended for 18" (460 mm) wide or wider ladder rack. Heavy-duty splices are required for any splice formed in the vertical orientation including changes in elevation formed using vertical-to-horizontal 90° turns or horizontal-to-vertical 90° turns. Use heavy-duty splices to secure all overhead turns to the overhead horizontal pathway(s).
7. When the pathway is overhead, ladder rack shall be installed with a minimum clearance of 12" (300 mm) above the ladder rack. Leave a minimum of 12" (300 mm) in between ladder rack and ceiling/building truss structure. Leave a minimum of 3" (75 mm) in between ladder rack and the tops of equipment racks and/or cabinets. Multiple tiers of ladder rack shall be installed with a minimum of clearance of 12" (300 mm) in between each tier of ladder rack. When located above an acoustical drop ceiling, leave a minimum of 3" (75 mm) clearance between the top of the drop ceiling tiles and the bottom of the ladder rack.
8. When installed under a raised floor, ladder rack shall be installed with a minimum 3" (75 mm) clearance between the top of the ladder rack and the bottom of the floor tiles or floor system stringers, whichever is lower in elevation. Maintain a 3" (75 mm) clearance between ladder racks wherever ladder racks cross.
9. Within each telecommunications room, ladder rack should be bonded together, electrically continuous, and bonded to the Telecommunications Grounding Busbar (TGB), unless otherwise noted in the specifications and contract documents. Ladder rack and turns shall be bonded across each splice with a bonding kit or with splices per the manufacturer's installation instructions. Ladder rack shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the ladder rack and a minimum #6 grounding wire or as recommended by the Authority having jurisdiction. Remove paint from the ladder rack where bonding/ground lugs or splices contact the ladder rack so that the lug or splice will contact bare metal. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual ladder rack sections and turns and through the bond to the Telecommunications Grounding Busbar (TGB).
10. The quantity of cables within the ladder rack will not exceed a whole number value equal to 50% of the interior area of the ladder rack divided by the cross-sectional area of the cable. The interior area of ladder rack will be considered to be the width of the ladder rack multiplied by a height of 2" (50 mm), unless cable retaining posts are added to the ladder rack. The interior area of ladder rack equipped with cable

retaining posts will be considered to be the width of the ladder rack multiplied by a height of 6" (150 mm). Actual cable fill for ladder rack that is not equipped with cable retaining posts will not exceed 2" (50 mm) in height. Actual cable fill for ladder rack equipped with cable retaining posts will not exceed 6" (150 mm) in height.

11. The combined weight of cables within the ladder rack will not exceed the stated load capacity of the ladder rack as stated in the manufacturer's product specifications or load/design tables.
12. Cables (cable bundles) will be secured to the cross members of ladder rack with 3/4" (19 mm) wide reusable straps. Straps are not required when ladder rack is equipped with cable retaining posts.
13. Add 8" (200 mm) high cable retaining posts to the open sides of ladder rack when cable fill exceeds 2" (50 mm) in height or when cable bundles cannot be secured directly to the ladder rack cross members with a strap. Cable fill within any ladder rack should not exceed 6" (150 mm) in height.
14. When a single ladder rack supports different types of cables media, the cable media will be separated within the pathway by cable spools that attach to the cross members on the ladder rack. Treat each type of cable media and divided area of the ladder rack separately when determining cable fill limits.
15. Use a radius drop to guide cables wherever cable exits overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field. If necessary, provide a moveable cross member also to attach and align the radius drop in between the welded cross members of a ladder rack.
16. Cover the exposed ends of cable runway that do not terminate against a wall, the floor or the ceiling with end caps or an end closing kit.
17. Use auxiliary support brackets that attach to the side stringer of the ladder rack to support interconnect cabling (patch cords, equipment cords, jumper cords) that is routed between racks using the ladder rack. Auxiliary support brackets can be used to support other conductors that should be physically separated from cables within the ladder rack as defined by local code or the Authority having jurisdiction.
18. Whenever possible, maintain a 2' (0.6 m) separation between ladder rack used for communications cables and pathways for other utilities or building services.
19. The installer will provide touch-up paint color-matched to the finish on the ladder rack and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting in from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the ladder rack system.

E. Rack-Mount Busbars and Ground Bars

1. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar or ground bar to the rack or cabinet. The rack-mount busbar or ground bar provides multiple bonding points on the rack for rack and rack-mount equipment.
2. Attach rack-mount busbars and ground bars to racks or cabinets according to the manufacturer's installation instructions.
3. Bond the rack-mount busbar or ground bar to the rooms Telecommunications Main Grounding Busbar (TMGB) or Telecommunications Grounding Busbar (TGB) with appropriately sized hardware and conductor.

F. Equipment Ground Jumper Kit

1. Bond equipment to a vertical rack-mount busbar or groundbar using ground jumper according to the manufacturer's recommendations.
2. Clean the surface and use antioxidant between the compression lugs on the jumper and the rack-mount busbar or groundbar to help prevent corrosion at the bond.

END OF SECTION 27 11 00

SECTION 27 11 19 – COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies the products and installation of communications termination blocks and patch panels for copper twisted-pair and optical fiber cables.
- B. The product performance (e.g., category 5e, category 6A, OM4, OS2) shall be as specified in Section 271513..

1.2 RELATED DOCUMENTS

- A. The latest editions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from the requirements in codes, standards, guidelines or specifications.
- B. The following codes, as required by law
 - 1. ANSI/NFPA-70, National Electrical Code® (NEC®)
- C. The following standards
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 - 3. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
 - 4. ANSI/TIA-569-C, Telecommunications Pathways and Spaces
 - 5. ANSI/TIA-606-B, Administration Standard for the Telecommunications Infrastructure
 - 6. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- D. The following guidelines
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
- E. The following project specifications
 - 1. 27 05 26 Grounding and Bonding for Communications
 - 2. 27 05 53 Identification for Communications Systems
 - 3. 27 15 13 Communications Copper Horizontal Cable
 - 4. 27 15 43 Communications Faceplates and Modular Jacks

1.3 QUALITY ASSURANCE

- A. Termination blocks and patch panels shall be covered by the Advanced System Warranty.

1.4 SUBMITTALS

- A. All submittals that are incomplete shall be returned without review.
- B. The following submittals shall be provided at the Pre-Construction Phase. The Owner's IT representative shall have final approval of products for the installation.
 - 1. Product Information
 - a. Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.
 - b. Provide manufacturer's product information showing system performance is maintained when using a variety of modular jacks (e.g., wall, patch panel), cable and patch cords (be manufacturer and product specific).
 - c. All product information shall be provided at one time, in one submittal package.
 - 2. Shop Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating location and type/part number of product to be installed. Additionally, provide (1/4" = 1'-0" scale or greater) drawing elevations for equipment cabinets, racks, frames, enclosures and wall terminations indicating locations of termination blocks and patch panels.
- C. The following submittals shall be provided three (3) weeks prior to Substantial Completion.
 - 1. Record Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating location and type/part number of product to be installed. Additionally, provide (1/4" = 1'-0" scale or greater) drawing elevations for equipment cabinets, racks, frames, enclosures and wall terminations indicating installed locations of wall termination blocks and patch panels.
 - b. All record drawings shall be provided at one time, in one submittal package.
 - 2. Manufacturer and Maintenance Manuals for installed equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All connectivity components for copper (e.g., patch panels, modular jacks) shall be by the same manufacturer and covered under the same manufacturer Advanced System Warranty.

2.2 COPPER BALANCED TWISTED-PAIR

- A. Wall-mounted 110-termination blocks and connectors (e.g., copper backbone termination, wall-to-rack termination)
 - 1. Performance shall meet the performance requirements of ANSI/TIA 568-C.2.
 - 2. Manufacturer shall be
 - a. Panduit
 - b. Approved equivalent

B. Angled patch panels

1. Size as identified on the drawings. Typical size is 48-port, 2RU.
2. Shall accept modular jacks that meet the required performance of the specified category system.
3. Manufacturer shall be
 - a. Panduit – Mini-Com opening(s)
 - b. Approved equivalent

C. (Straight; flat) patch panels

1. Size as identified on the drawings. Typical size is 48-port, 2RU.
2. Shall accept modular jacks that meet the required performance of the specified category system.
3. Manufacturer shall be
 - a. Panduit – Mini-Com opening(s)
 - b. Approved equivalent

PART 3 - EXECUTION**3.1 GENERAL**

- A. Termination block and patch panel installation (copper and optical fiber) shall be in conformance to ANSI/TIA-568 standards, BICSI methods, industry standards and manufacturer's instructions and guidelines.
- B. Termination blocks and patch panels terminated in areas prior to final cleaning (e.g., painting, carpet installation, where dust may be created) shall be protected to ensure dust, debris, moisture and other foreign materials do not settle onto contacts or optical fiber end-faces.
- C. Cables shall be terminated in consistent consecutive order.
- D. Coordinate with all other trades prior to pre-construction submittals and installation.
- E. Quantity on drawings is illustrative. Provide the quantity of wall-termination blocks and connectors, patch panels, enclosures and inserts to support the necessary quantity of cable pairs and strands plus 10%.

3.2 COPPER BALANCED TWISTED-PAIR

- A. Follow 27 15 43 Communications Faceplates and Modular Jacks for terminations.
- B. Cables shall be supported and loosely tied off by means of a strain relief bar on the back of patch panels.
- C. Contractor shall terminate copper backbone (riser) cables onto wall-mounted 110 termination blocks using C-5 connectors.

- D. Wall-to-rack cables shall be terminated between the backbone 110 termination field and patch panel(s). The wall-to-rack cables shall be 100 pair category 3. The 110 termination block shall be terminated with five (5) C4 connectors and one (1) C5 connector per 25-pair row. Four pair per port shall be terminated on the patch panels that follow the T568B configuration.
- E. Provide a separate patch panel(s) in each Communications Room for Wireless Access Points.
- F. Provide a separate patch panel(s) in each Communications Room for Building Automation Controls, Security and Elevators.
- G. Provide a separate patch panel(s) in each Communications Room for wall-to-rack copper backbone.

END OF SECTION 27 11 19

SECTION 27 15 13 – COMMUNICATIONS COPPER HORIZONTAL CABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section shall govern the products and installation of category copper horizontal cable.
- B. The cable performance shall be Category 6.

1.2 RELATED DOCUMENTS

- A. The latest versions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from requirements in codes, standards, guidelines or specifications.
- B. The following codes, as required by law:
 - 1. National Electrical Code® (NEC®)
- C. The following standards:
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 - 3. ANSI/TIA-569-C, Telecommunications Pathways and Spaces
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
- E. The following project specifications:
 - 1. 27 05 26 Grounding and Bonding for Communications
 - 2. 27 05 37 Firestopping Systems for Communications Cabling
 - 3. 27 05 53 Identification for Communications Systems
 - 4. 27 08 20 Copper Testing
 - 5. 27 11 19 Communications Terminations Blocks and Patch Panels
 - 6. 27 15 43 Communications Faceplates and Modular Jacks

1.3 SUBMITTALS

- A. The following submittals shall be provided at the Pre-Construction Phase:

1. All submittals that are incomplete shall be returned without review.
 2. Product Information
 - a. Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.
 - b. Provide manufacturer's product information showing system performance is maintained when using a variety of modular jacks (wall, patch panel) and patch cords (be manufacturer and product specific).
 3. Shop Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating routing of copper horizontal cabling.
- B. The following submittals shall be provided three (3) weeks prior to Substantial Completion
1. Record Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating actual installed routing of copper horizontal cable. Design or shop drawings modified in the field shall not be accepted.
 2. Manufacturer and Maintenance Manuals for all installed equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The Contractor shall utilize a single manufacturer brand for copper horizontal cable.

2.2 BALANCED TWISTED-PAIR TELECOMMUNICATIONS CABLE

- A. Cable shall be balanced twisted-pair, four-pair, unshielded, with an overall jacket.
- B. Cable performance shall meet the performance of ANSI/TIA-568-C.2.
- C. Cable shall be listed by a Nationally Recognized Testing Laboratory (NRTL).
- D. Cable installed in buildings shall be CMP listed per the NEC (Article 800).
- E. Cable shall be rated for use in return air Plenums.
- F. Un-listed cable shall only be permitted for entrance to a building and be limited to 50 feet (see NEC Article 800).
- G. Cable sheath shall be blue with white or black lettering. Wet-rated cable sheath shall be black with white lettering. The lettering (marking) shall indicate the following:
1. Manufacturer name
 2. Pair count
 3. American Wire Gauge (AWG)

4. Listing
 5. Performance rating (category 6)
 6. Sequential length markings, in one foot increments
- H. Cable manufacturers
1. Panduit
 2. Berktek/Leviton
 3. Approved equivalent

PART 3 - EXECUTION

3.1 GENERAL

- A. Copper horizontal cable shall have its own support structure. Support all horizontal cable continuously (e.g., conduit, cable tray) or a maximum of every 5 feet with j-hooks. Cable shall not contact suspended ceiling and should be installed such that it is a minimum of 6 inches above any portion of the suspended ceiling. The suspended ceiling nor the suspended ceiling support wire shall be used to support cable.
- B. Cable shall be installed in a continuous length from communications room to outlet.
- C. The maximum installed cable length (physical length) shall be 295 feet.
- D. Cable installation shall be in conformance to ANSI/TIA-568 standards, BICSI methods, industry standards and manufacturer's installation guidelines.
- E. Cable installation shall not exceed 25 lb. pulling tension.
- F. Cable installation shall not exceed a cable bend radius of 4-times the cable diameter while under load or no-load conditions.
- G. Provide at the communications room a minimum of 6 feet of service loop that is dressed on the cable tray above the termination point (typically within the cable tray).
- H. Provide a minimum of 36 inches of cable for service loop above the drop location for the outlet location. Service loops shall be 12 to 18 inches in diameter.
- I. Modular furniture cables shall terminate within the modular furniture and shall have a minimum of 36 inches of cable for service loop above the drop location. Service loops shall be 12 to 18 inches in diameter.
- J. Provide forty-eight (48) 3-ft patch cables. Cables shall be of the same specification as listed above.
- K. Provide five (5) 15-ft patch cables. Cables shall be of the same specification as listed above.
- L. Cable shall be installed with a minimum separation from EMI sources:

1. 12 inches from power lines enclosed in a grounded metal conduit.
 2. 6 inches from fluorescent light fixtures
 3. 48 inches from electrical motors or transformers.
- M. Coordinate pathways and installation with all other trades prior to installation.
- N. Lubrication shall not be used on cable.
- O. The cable shall not be painted for any length. Cable that is painted shall be replaced at no cost to the owner/project.
- P. All copper horizontal cabling shall be tested in accordance with section 27 08 20 Copper Testing.
- Q. For outside-plant cables to be installed as part of the contract documents that are not listed, provide a transition point and enclosure in an accessible location for transition listed to un-listed cable.
1. Indicate the transition location on the Record Drawings.

END OF SECTION 27 15 13

SECTION 27 15 43 – COMMUNICATIONS FACEPLATES AND MODULAR JACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section shall govern the products and installation of communications faceplates and modular jacks.
- B. The product performance shall be Category 6.

1.2 RELATED DOCUMENTS

- A. The latest editions of the following codes, standards, and guidelines shall be followed. Bring to the Owner's IT representatives' immediate attention where construction documents or conditions differ from the requirements in codes, standards, guidelines or specifications.
- B. The following codes, as required by law:
 - 1. National Electrical Code® (NEC®)
- C. The following standards:
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 - 2. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 - 3. ANSI/TIA-570-C, Residential Telecommunications Infrastructure Standard
 - 4. ANSI/TIA-569-C, Telecommunications Pathways and Spaces
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)
 - 2. BICSI, Information Transport Systems Installation Methods Manual (ITSIMM)
- E. The following project specifications:
 - 1. 27 05 53, Identification for Communications Systems

1.3 SUBMITTALS

- A. The following submittals shall be provided at the Pre-Construction Phase, Communications. The Owner's IT representative shall have final approval of products for the installation.
 - 1. Product Information
 - a. Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.

- b. Provide manufacturer's product information showing system performance is maintained when using a variety of modular jacks (e.g., wall, patch panel), cable and patch cords (be manufacturer and product specific).
 - 2. Shop Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating location and type/part number of faceplate and modular jack to be used. This information may be included on shop drawing for 27 05 53, Identification of Communications Systems.
- B. The following submittals shall be provided three (3) weeks prior to Substantial Completion:
 - 1. Record Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating location and type/part number of faceplate and modular jack installed. Design or shop drawings modified in the field shall not be accepted. This information may be included on record drawing for 27 05 53 Identification of Communications Systems.
 - b. Manufacturer and Maintenance Manuals for installed equipment.
 - c. All submittals that are incomplete shall be returned without review.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Faceplates and modular jacks shall be by the same manufacturer except as noted on drawings and this specification. This manufacturer shall be the same manufacturer that supplies the manufacturer advanced system warranty.

2.2 FACEPLATE

- A. Typical work-area outlets:
 - 1. Single-Gang Faceplate
 - a. Color and material shall meet requirements for environment and match electrical faceplates.
 - b. Shall have a recessed label field with high impact thermo-plastic cover.
 - c. Manufacturer shall be:
 - 1) Panduit – Mini-Com opening(s)
 - 2) or equivalent
 - 2. Double-Gang Faceplate
 - a. Color and material shall meet requirements for environment and match electrical faceplates.
 - b. Shall have a recessed label field with high impact thermo-plastic cover.
 - c. Manufacturer shall be:
 - 1) Panduit – Mini-Com opening(s)
 - 2) or equivalent

B. Above-ceiling outlets for wireless access points:

1. Single-Gang Faceplate
 - a. Shall be stainless steel in construction.
 - b. Manufacturer shall be:
 - 1) Panduit – Mini-Com opening(s)
 - 2) or equivalent

2.3 MODULAR JACK (INCLUDING SURFACE-MOUNT)

A. Category modular jacks

1. Performance shall meet that of ANSI/TIA-568-C.2.
2. Material shall meet requirements for environment and match electrical faceplates.
3. Color of CAT6 keystone jacks shall be Blue.
4. Manufacturer shall be:
 - a. Panduit – Mini-Com
 - b. or equivalent

PART 3 - EXECUTION

3.1 GENERAL

- A. Follow all manufacturers' instructions.
- B. Faceplates and modular jack installation shall be in conformance to ANSI/TIA-568 standards, BICSI methods, industry standards and manufacturer's guidelines.
- C. Coordinate with all other trades prior to pre-construction submittals and installation.

3.2 FACEPLATE

- A. Faceplates shall be installed straight and plumb in all directions.
- B. Faceplates shall be installed with screws.
- C. Should the faceplate not cover the entirety of the outlet box hole in the wall due to overcutting or rough workmanship, the wall shall be appropriately patched and painted for a neat and clean finished appearance.
- D. Fill all module openings with blank modules.

3.3 MODULAR JACK (INCLUDING SURFACE-MOUNT)

- A. All category modular jacks shall be terminated using the T568B termination scheme specified in ANSI/TIA-568-C.0.

- B. Modular jacks terminated in areas prior to final cleaning (e.g., painting, carpet installation, dusty areas) shall be placed in a protective envelope to ensure dust, debris, moisture and other foreign materials do not settle onto modular jack contacts. Once final cleaning is complete, modular jacks shall be inserted into faceplates and screwed into place.
- C. Pair-twist shall be maintained up to the point of termination.
- D. Cable sheath shall be maintained up to within 0.5 inches of the modular jack termination.

END OF SECTION 27 15 43

SECTION 31 31 16 – SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

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. Soil treatment with termiticide. Section includes treating complete subgrade both inside and outside the perimeter building grade beams, piers, and entire subgrade below building slabs-on-grade and to a line five (5) feet beyond the perimeter walls of Electrical, Storage, Data, Security Rooms with termiticide.

- B. Related Sections:

- 1. Section 06 10 00 "Rough Carpentry" for wood preservative treatment by pressure process.
 - 2. Section 31 23 13 "Subgrade Preparation" for coordination with site preparation.
 - 3. Section 32 91 13 "Soil Preparation" for coordination with soil preparation.

1.3 REFERENCES

- A. U.S. Environmental Protection Agency (EPA):

- 1. 7 USC Section 136 – Federal Insecticides, Fungicide, and Rodenticide Act.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of termite control product.

- 1. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Product Certificates: For termite control products, from manufacturer.

- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- D. Research/Evaluation Reports: For metal mesh barrier system, from.
- E. Warranties: Sample of specified warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products, and who is accredited by manufacturer.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single source.
- D. Pre-installation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.
- C. Apply wood treatment after framing, sheathing, and exterior weather protection is completed but before electrical and mechanical systems are installed.

1.8 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. FMC Corporation, Agricultural Products Group; Dragnet FT.
 - d. Syngenta; Demon TC.
 - e. Or Approved Equal.
 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 - 4. Masonry: Treat voids.

- 5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 31 31 16

SECTION 32 15 46 - STABILIZED DECOMPOSED GRANITE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of Stabilized Decomposed Granite (D.G.) Paving as shown on the Drawings and as specified in this Section.
- B. All references to D.G. paving shall also apply to Stabilized D.G paving, unless otherwise noted.

1.03 DEFINITIONS

- A. Relative compaction: is defined as the in-place dry density of the compacted soil divided by the laboratory compacted maximum dry density determined according to ASTM D1557-78 (Modified Proctor Density) latest edition, expressed as a percentage.

1.04 SUBMITTALS

- A. General: Within fourteen (14) days after Notice to Proceed submit the following:
- B. Decomposed Granite: sieve analysis and one quart sample.
- C. Installer to submit evidence to indicate successful experience in providing decomposed granite containing specified stabilizer binder additive.
- D. Mixing Facilities: Method or supplier source for paving product, with sufficient notice so inspection of batching and mixing operations can be made.

1.05 REVIEWS

- A. Contractor shall stake and layout all paving areas for review by the Architect prior to excavation.
- B. Contractor shall provide 4'x4' mock-up for approval. Mock-up shall remain in place for the duration of the stabilized DG installation and shall be the basis of acceptance

PART 2 – PRODUCTS

2.01 BASE

- A. Aggregate Base: Shall be Type A, Grade 1, in accordance with TxDOT item 247 unless otherwise indicated by the Owner.

2.02 DECOMPOSED GRANITE

- A. Decomposed Granite: Clean, hard, durable particles or fragments of Texas Hill Country decomposed granite gravel with fines evenly mixed throughout the aggregate and free from clay lumps, vegetable matter and deleterious material. Size at 3/8" minus with no more than 25% passing no. 200 sieve; available from Keller Material, Inc., San Antonio, Texas, (210) 648-4221, or approved equal.

2.03 STABILIZER

- A. Stabilizer Binder: Non toxic, GraniteCrete powder, natural color as available from Klepzig, Inc. Georgetown, TX (512) 845-1939. Standard color to be determined by Architect. Installations over 3,000 square feet require the use of a volumetric truck, calibrated for the GraniteCrete mixture.

2.04 PRE-EMERGENT

- A. Granular: Treflan, Ronstar or approved equal.

2.05 GEOTEXTILE FABRIC

- A. Geotextile Fabric: Shall be Mirafi 180N, Non-biodegradable, non-woven, polyester geotextile fabric; manufactured by Mirafi Construction Products, 365 South Holland Drive, Pendergrass, GA, USA 30567; 1-888-795-0808; 1-706-693-2226; 1-706-693-2083, fax; www.mirafi.com; or approved equal. Representative: Bastalla Corporation, Houston, Texas (713) 939-8788.

2.06 EXCESS MATERIALS

- A. Provide Owner aggregate paving blended with proper amount of Stabilizer in 50 lb bags until excess material is depleted.

PART 3 – EXECUTION

3.01 GENERAL

- A. Grades: The finish grades of the paving shall conform to the lines and grades on the Drawings and allow for drainage. Edges of paving shall be flush with adjacent edging, concrete, or other paving.
- B. Preparation: Prior to installing paving install pre-emergent herbicide to sub-grade per manufacturer's recommendations.

3.02 BASE PREPARATION

- A. Subgrade: Compact sub-grade under all stabilized DG areas to 95%. Verify that sub-grade preparation, compacted density and elevations conform to the Specifications. Use caution near underground pipes and utilities.
- B. Place geotextile over prepared subgrade per manufacturer's recommendations. Overlap at edges, 2' minimum, securing with plastic ties. Equipment and vehicles shall not pass directly over geotextile. Damaged geotextile shall be replaced immediately per manufacturer's recommendations to the Owner's satisfaction, and at the Contractor's sole expense.
- C. Place, spread, and compact the aggregate base in such a manner that minimizes the development of wrinkles and movement in the geotextile. Sprinkle in accordance to TxDOT Item 204 to control dust. Determine the moisture content at the beginning of, and during compaction in accordance with TxDOT Tex-103-E. Compact aggregate base to at least 95% of the maximum density determined in accordance with Tex-121-E, and to a depth as noted on the Drawings. Verify grades to allow for finish paving. The Contractor shall, in the presence of the Owner's representative, determine density at four locations. If the material fails to meet density requirements, it shall be reworked as necessary to meet these requirements and retested.
- D. Clear aggregate base surface of all loose or unsuitable material.

3.03 STABILIZED D.G. INSTALLATION

- A. Mixing: Blend per manufacturer's instructions.
- B. Placement: Do not install blended material when aggregate base is wet or saturated, or during rainy conditions or below 40 degrees F. Do not install blended material until aggregate base has been prepared per 3.02 above. The Stabilized D.G. shall be deposited in such a manner as to minimize the necessity for spotting, picking up or otherwise shifting the material. The mixing shall not be screeded off or finished by floating. No steel tooling of the material shall be done. Place blended material over prepared base at sufficient thickness to allow for compaction, about 1" above surrounding edges, and rake smooth using a steel tine rake to desired grade and cross section removing aggregate 1/2" or greater from surface of path. Roll per manufacturer's instructions.
- C. Compaction: While blended aggregate paving is still thoroughly moist (not wet or dry), roll with a heavy lawn roller per manufacturer's instructions, making several passes, to achieve finish grade and final compaction. Compact until there are no visible marks from compaction. Hand tamp edges where rolling is not feasible, paying particular attention to corner and edges. Keep tampers and rollers clean at all times. Fill any divots with fresh, loose material, and hand tamp to match the surrounding finish. Do not use whackers or vibratory rollers. If laying GraniteCrete in batches, discuss installation method with Architect prior to delivering material.
- D. Watering: DO NOT ALLOW GRANITECRETE TO DRY DURING INSTALLTION. Mist lightly with a hose-end sprayer as necessary, or cover with a plastic tarp. The final step for a GraniteCrete installation is a dampening with water of all newly-installed and compacted GraniteCrete materials. Using a shower head/spray hose attachment, moisten the entire newly-

installed GraniteCrete area - avoid puddling. For best results, moisten all newly-installed GraniteCrete

paving a second time the following 1 to 5 days, as practical. Slow curing of GraniteCrete is important to avoid cracking. Make sure there is no direct application of uncontrolled watering, such as irrigation before final curing. GraniteCrete is fully cured in 28 days. Avoid foot traffic on newly installed GraniteCrete for at least 48 hours.

- E. Final Review: Finished surface of paving shall be smooth, uniform, and solid, with no evidence of loose material 3/8" or greater present on the surface. Dried, compacted paving material shall be firm all the way through with no spongy areas. Any significant irregularities shall be smoothed out prior to Final Acceptance of work. Final thickness of completed paving shall not be less than the compacted dimension indicated.

3.04 CLEAN UP

- A. Waste Removal: All waste as a result of paving construction shall be removed from the site and disposed of legally. All excess paving material shall be removed from adjacent planting areas.

3.05 MEASUREMENT AND PAYMENT

- A. The Contract lump sum price paid for Stabilized D.G. Paving shall be considered full compensation for furnishing all labor, material, equipment, tools, and incidentals, for all work involved as specified in this Section, as shown on the Drawings, and as directed by the Architect, and no separate payment shall be made.

END OF SECTION

SECTION 32 93 03 - LANDSCAPE PLANTING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the provision and installation of plant materials as shown on the Drawings and as specified in this Section.

1.03 QUALITY ASSURANCE

- A. Quality: Minimum quality of all plant material shall unless otherwise indicated conform to:
 - 1. ANSI Z60.1-2004 American Standard for Nursery Stock, Sponsored by the American Nursery and Landscape Association (ANLA)
 - 2. Additional standards as indicated on the Drawings and as specified herein.
- B. Applicable ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:
 - 1. C602 Specification for Agricultural Liming Materials
 - 2. D5268 Specification for Topsoil Used for Landscaping Purposes

1.04 SUBMITTALS

- A. General: Within fourteen (14) days after Notice to Proceed submit the following:
 - 1. Documentation certifying quantity and species of plant material ordered, the nursery supplier(s), *any* plant material not available at that time, or proposed substitutions to be reviewed.
 - 2. Product data on all associated planting products specified herein.

1.05 REVIEWS

- A. Contractor shall specifically request at least (2) two days in advance the following review prior to progressing with the work:
 - 1. Intermediate Review – plant material approval and staked tree locations. See Specification
- B. Contractor shall specifically request at least (5) five days in advance the following reviews prior to progressing with the work:
 - 1. Substantial Completion Review (to initiate Maintenance Period) – all planting areas.
 - 2. Final Review (at the completion of Maintenance Period) - all planting areas, and all punch-list items identified at Substantial Completion Review.

- C. Each review shall be conducted only after all items pertaining to that review as noted above and in related Sections have been completed by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Nomenclature and Labels: Plant botanical names conform to “Standardized Plant Names,” second edition. All plants of each clone, species, and cultivar shall be delivered to the site labeled with their full botanical name. Every plant species shall be labeled with no less than one label for every ten plants of a species.
- B. Quantities: The quantities shown on the plant list and in labels are for the Architect's use and are not to be construed as the complete and accurate limits of the Contract. Contractor shall furnish and install all plants shown schematically on the Drawings.
- C. Root Systems: All container-grown stock shall be grown in its container for at least six months prior to its planting. Contractor shall allow one percent of the quantity of plants for removal and inspection. Any plant material, within two years following the final acceptance of the project, determined by the Architect to be defective, restricted, declining or otherwise deficient due to abnormal root growth, shall be replaced by the Contractor, to the equal condition of the adjacent plants, at the time of replacement.
- D. Health: Foliage, roots and stems of all plants shall be of vigorous health and normal habit of growth for its species. All plants shall be free of all disease, insect stages, burns or disfiguring characteristics.
- E. Untrue Species: All plant material, within two years following the final acceptance of the Project, determined by the Owner to be untrue to the species, clone, and/or variety specified, shall be replaced by the Contractor, to the equal condition of adjacent plants at the time of replacement.

2.02 TREES

- A. All trees shall have straight trunks of uniform taper, larger at the bottom. Trunks shall be free of damaged bark, with all minor abrasions and cuts showing healing tissue. Sucker basal growth and lateral growth shall be removed and treated to eliminate re-sprouting. Normal lower side branching shall remain. Trees unable to stand upright without support shall be rejected.

2.03 FERTILIZER

- A. 20-10-15 (N-P-K) Commercial Fertilizer, uniform pellet.
 - 1. The requirements above are for bidding purposes only, exact fertilizer types per Testing Lab analysis.

2.04 TREE STAKING

- A. Tree staking shall be as specified in the drawings.

PART 3 - EXECUTION

3.01 GENERAL

- A. Plant Material Approvals: Before planting operations commence, all plant material shall be reviewed by the Architect. Defective plants shall be removed from the site and acceptable material substituted in its place. The review does not accept defective plants which may be installed.
- B. Layout: Only those plants to be planted in any single day should be laid out. Locations of all plants shall be reviewed prior to planting. Plants installed without this review may be transplanted/relocated as directed by the Architect.
- C. Protection of Plants: Contractor shall maintain all plant material in a healthy growing condition prior to and during planting operation. Contractor shall be responsible for vandalism, theft, and damage to plant material until commencement of the maintenance period.
- D. Pruning: Contractor shall do no pruning without specific authorization of the Architect. Plants pruned without authorization shall be replaced by the Contractor if necessary.

3.02 PLANT PITS

- A. Rootball shall rest only on undisturbed soil, or in the case of fill areas, on compacted, un-amended sub-grade. Plant rootball and pits shall have their sides and bottoms loosened and otherwise broken to prevent glazing or compaction.
 - 1. Plant pit sizes shall be as shown on the Drawings.
 - 2. Plant pits in paved areas shall extend to the edge of the planter opening in all directions unless otherwise noted on the Drawings.

3.03 TREE INSTALLATION

- A. Watering basins: Construct basins as required to water plants during establishment period. Basin bottoms shall drain away from plant stems. See Specification Section Landscape Maintenance for removal of basins.
- B. Staking: All trees shall be staked unless otherwise noted on the Drawings. Install stakes as per the Details.

3.04 CHEMICALS

- A. Pesticide: Contractor shall verify compatibility, dosage and other application procedures with the manufacturer. All pesticides shall be applied by a pest control operator licensed in the State of Texas.
- B. Include copies of documentation of pesticide applications, countersigned by the Architect, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.05 FERTILIZER

- A. Apply Agriform plant tabs per details.

3.06 CLEAN UP

- A. After completion of all operations, Contractor shall remove all trash, excess soil and other debris. All walks, walls, and pavement shall be swept and washed clean. Leave the entire area in a neat, orderly condition.

3.07 MEASUREMENT AND PAYMENT

- A. The Contract lump sum price paid for Landscape Planting shall be considered full compensation for furnishing all labor, material, equipment, tools, and incidentals, for all work involved as specified in this Section, as shown on the Drawings, and as directed by the Architect, and no separate payment shall be made.

END OF SECTION