GCCC SOLAR WATER HEATING UPGRADES
WASILLA, ALASKA
PROJECT NUMBER GAE2020012

100% CONSTRUCTION DOCUMENTS

APRIL 5, 2016

SPECIFICATIONS

BETTISWORTH NORTH
ARCHITECTURE PLANNING LANDSCAPE INTERIORS

VOLUME 1

DIVISION 33 – UTILITIES

NOT USED

END OF SECTION 00 00 00

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of selective demolition activities with starting and ending dates for each activity.

1.5 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Assemblies include, but are not limited to:

1. EPDM Roofing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

*B. [**Perform**] [**Engage a professional engineer to perform**] an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.*

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Coordinate with Owner for required service interruptions.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least **4** hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 CLEANING

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.

2. Post Installed Concrete Anchors.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference for roof mounted installations at Project site.

1.5 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural steel, including chemical and physical properties.

C. Source quality-control reports.

D. Post Installed Concrete Anchors:

1. Product specifications with recommended design values and physical characteristics for all post installed concrete anchors.

2. ICC ES Evaluation Reports.

3. Manufacturer’s installation instructions.

4. Installer Qualifications & Procedures: Submit installer qualifications. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, and a list of the personnel qualified for anchor installation

E. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD**,** or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Comply with applicable provisions of the following specifications and documents:

1. AISC 360.

2. AISC 303.

3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Post Installed Concrete Anchors:

1. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:

a. ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

2. Installer Qualifications: Drilled-in anchors shall be installed by an installer with at least three years of experience performing similar installations.

3. Special lnspection: Owner shall retain a qualified IBC Special Inspector to provide special inspection of post installed anchors. Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC and 2012 18C; Section 1704.15 and Table 1704.4 of the 2009 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, anchor spacing, edge distances, concrete member thickness, tightening torque, hole dimensions, anchor embedment and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection." Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all hot dip galvanized.

B. Stainless Steel Bolts, Nuts, Washers and Lock Washers: ASTM A316

C. Post Installed Concrete Anchors

1. Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings conforming to ICC ES AC01 or ICC ES AC193. Type and size as indicated on Drawings.

2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. Stainless steel nuts shall conform to ASTM F594 unless otherwise specified.

3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following or equal:

a. Hilti Kwik Bolt TZ, ICC ESR-1917 (AISI Type 316 Stainless Steel) or equal.

2.3 COATINGS

A. All exterior steel not indicated to be stainless steel shall be hot-dip galvanized per ASTM A123 or ASTM A153 as applicable.

B. Provide zinc rich paint per ASTM A780 for field coating of welds and damaged shop coatings.

2.4 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

2.5 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

PART 3 - EXECUTION

3.1 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

3.2 FIELD CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for alignment, adequacy of temporary connections, and removal of paint/galvanizing on surfaces adjacent to field welds.

2. Submit fire prevention procedures that will be used when welding roof solar collector frames to existing roof trusses. Use weld blankets as required while welding at roof penetrations. Protect areas below existing roof with fire resistant material when performing welds to existing roof trusses. Employ qualified personnel to observe areas below existing roof for welding sparks during roof truss welding.

B. Post Installed Concrete Anchors:

1. Drill holes with rotary impact hammer drills **using carbide-tipped bits**. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.

a. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging, electrical and telecommunications conduit, and other utilities.

2. Perform anchor installation in accordance with manufacturer instructions.

3. Wedge Anchors: The Hilti KB-TZ must be installed in accordance with manufacturer's published instructions and the ICC-ES Report. In case of conflict, the ICC-ES report governs. Installation parameters are provided in the drawings. Protect threads from damage during anchor installation. Anchors must be installed in holes drilled into the concrete using carbide-tipped masonry drill bits complying with ANSI 8212.15-1994. The minimum drilled hole depth is noted in the drawings. Prior to installation, dust and debris must be removed from the drilled hole to enable installation to the stated embedment depth. The anchor must be hammered into the predrilled hole until h_{nom} is achieved. The nut must be tightened against the washer until the torque values noted in the plans are achieved. Set anchors to manufacturer’s recommended torque, using a torque wrench. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

4. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.3 FIELD COATINGS

A. Apply zinc rich paint per ASTM A780 to weld areas and other damaged shop coatings. Surfaces shall be clean, dry and free of oil, grease and corrosion by-products. Remove all weld flux

residue and weld spatter. Power tool clean areas in accordance with SSPC-SP3. Apply zinc coating to a minimum DFT of 3 mils.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.

2. Verify weld materials and inspect welds.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections for tightness per the drawings notes.

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

E. Post Installed Concrete Anchors:

1. Testing: 20% of each type and size of drilled-in anchor shall be torque tested by an independent testing laboratory. If any of the tested anchors fail to achieve the specified torque within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.

   a. Torque shall be applied with a calibrated torque wrench.

2. Minimum anchor embedments, proof loads and torques shall be as shown on the Drawings.

END OF SECTION 051200

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SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes self-adhering membrane sheet waterproofing.

1.2 RELATED SECTIONS

A. Section 07 25 00 “Weather Barriers” for pre-molded flashing panels integrated into weather barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements in Manufacturer’s written instructions.

B. Deliver materials to site in unopened containers with visible labels.

C. Storage and Protection:

1. Store Products within manufacturer’s required temperature and humidity ranges.
2. Prior to use, condition products within manufacturer’s required temperature and humidity ranges.

1.5 PROJECT CONDITIONS

A. Environmental Requirements

1. Apply flashing when the following are within the manufacturer’s limits during and for 4 hours after membrane installation:

   a. Ambient and surface temperatures.
   b. Relative humidity.

2. Do not apply to wet surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer Technical Representative shall be on-site during the beginning of Wet-Flash installation to verify proper application procedures and assist with initial installation as necessary.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

C. Warranty:

1. Manufacturer standard materials warranty.
2. Applicators 2 year labor and materials water-tight warranty.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 25-mil nominal thickness, self-adhering sheet consisting of rubberized asphalt laminated on one side to a polyethylene-film reinforcement, and with release liner on adhesive side. Basis of Design: Grace Vycor Butyl Self-Adhesive Flashing or similar products subject to compliance with the requirements.

1. Physical Properties:

a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
g. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
h. Hydrostatic-Head Resistance: 200 feet (60 m) minimum; ASTM D 5385.

2. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

PART 3 - EXECUTION

3.1 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Prepare surfaces and install modified bituminous sheets in strict accordance with waterproofing manufacturer's written instructions and recommendations in ASTM D 6135. When in conflict, use most stringent application guideline.

B. Provide protection, heat and ventilation required for proper installation.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

3.2 QUALITY CONTROL

A. General Contractor and manufacturer’s Technical Representative to continually review and supervise installation to ensure a weather tight installation.

3.3 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings

where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 26

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Foam-plastic board insulation.
2. Glass-fiber blanket.
3. Glass-fiber board.
4. Mineral-wool blanket.
5. Spray Polyurethane Foam Insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. For adhesives and sealants, provide printed statement of VOC content.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports: For each product, for tests performed by a qualified testing agency.

B. Research reports: For foam-plastic insulation, board and sprayed types, from ICC-ES.

1.4 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 the 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 as necessary 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 MOLDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Molded Polystyrene Board, Type II: ASTM C 578, Type II, 20-psi minimum compressive strength.

1. Flame Spread and Smoke-Developed Indexes: 75 and 450, respectively, per ASTM E84.
2. Thermal Resistance: 4.55 per inch of thickness in accordance with ASTM C518.
3. Locations and Thicknesses:

a. Roof: 10 inches minimum thickness, R=40. Minimum does not include crickets used for slope or match existing.

2.2 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. (32 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (25 mm of 43 K x sq. m/W at 24 deg C).

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. BASF Corporation.
b. CertainTeed Corporation.
c. Dow Chemical Company (The).
d. Gaco Western LLC.
e. Henry Company.
f. Icynene Inc.
g. Johns Manville; a Berkshire Hathaway company.
h. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company.
i. SWD Urethane Company.
j. Volatile Free, Inc.

2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread and Smoke-Developed Indexes: 25 or less and 450 or less, respectively.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

4. Thermal Barrier: Provide minimum 15 minute thermal barrier per IBC Section 2603, based on FM 4880, UL 1040, NFPA 286, or UL 1715.

    a. International Fireproof Technology, Inc. DC 315.
    b. Approved equal.

5. Primer: As recommended by manufacturer.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
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.

    a. Thermal Barrier: Provide minimum 15 minute thermal barrier per IBC Section 2603, based on FM 4880, UL 1040, NFPA 286, or UL 1715.

        1) International Fireproof Technology, Inc. DC 315.
        2) Approved equal.

    b. Primer: As recommended by manufacturer.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 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. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. 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.

END OF SECTION 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wrap.
2. Flexible flashing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cosella-Dörken Products, Inc, "Delta Fassade S"
   b. VaproShield, "RevealShield".
   c. Or approved equal.

2. Water-Vapor Permeance: Not less than 25 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).
3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

A. Flexible Flashing: Self-adhesive compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm). Flashings and tape shall be compatible and approved by the barrier manufacturer for use as a weather barrier system.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

B. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
2. Lap flashing over water-resistive barrier at bottom and sides of openings.
3. Lap water-resistive barrier over flashing at heads of openings.

END OF SECTION 07 25 00

SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system for repairs to existing roof system where damaged as a result of the Work.
2. Vapor Retarder.
3. Flexible walkways.

B. Related Requirements:

1. Section 02 41 19 “Selective Demolition” for demolition related to new roof penetrations and warranty integrity requirements for repairs to the existing roofing system.
2. Section 07 92 00 “Joint Sealants.”
3. Division 23 for HVAC elements.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

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

1. Conduct meeting prior to beginning the Work.
2. Meet with Owner, Architect, Owner’s insurer if applicable, roofing Installer, roofing system manufacturer’s representative, testing and inspecting agency and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
3. Review protection requirements for existing roof and new roofing accessories during construction and after installation.
4. Review methods and procedures related to roofing accessory installation and roofing system repair, including manufacturer’s written instructions.
5. Review roof observation and repair procedures after equipment and walkway installation.

1.4 SUBMITTALS

A. Product Data: For each type of product.

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

C. Samples for Verification: For the following products:

1. Walkway pads or rolls, of color required.

D. Qualification Data: For Installer and manufacturer.

E. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in “Performance Requirements” article.

1. Submit evidence of complying with the requirements.

G. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by qualified testing agency.

H. Field quality-control reports.

I. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and approved by the Owner’s insurer.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer’s name, product brand name and type, date of manufacture, approval or listing agency markings and directions for storing and mixing with other components.

B. Store liquid materials in their original, undamaged containers in a clean, dry and protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, fasteners, cover boards, substrate board and roofing accessories.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Wind Warranty: Manufacturer agrees to repair or replace components of roofing system that fail when exposed to wind forces up to 120 miles per hour (3 second gust) within specified warranty period.

1. Special Warranty includes membrane roofing, base flashings, fasteners, cover boards, substrate board, roof copings and accessories.
2. Warranty Period: 20 years from date of Substantial Completion.

1.10 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Roofing shall be design to resist the wind uplift pressures listed on the Structural drawings for Field, Edge, and Corner zones.

D. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs of existing roofing assembly. Identify products with appropriate markings of applicable testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 EPDM ROOFING

A. EPDM: ASTM D 4637, Type II, scrim or fabric internally reinforced, uniform, flexible EPDM sheet. Match existing thickness, but no less than 90 mils nominal, and match exposed face color.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55- to 60-mil- (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Bonding Adhesive: Manufacturer's standard.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer’s standard butyl mastic sealant.

G. Water Cutoff Mastic: Manufacturer’s standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer’s standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3mm) thick, with anchors.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer. Includes formed steel galvanized washer plates.

1. Fasteners shall be #12 x length required. Pattern shall match existing. Custom lengths may be required due to cricket depth on portions of the roof.
2. Fastening plates shall be 2-1/2” diameter minimum, 26 gauge minimum.

J. Miscellaneous Accessories: Pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board/ Thermal Barrier Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick, or match existing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate panel to roof deck.

2.5 VAPOR RETARDER

A. Vapor Retarder (Roof): 40-mil thick, self-adhered air and vapor retarder membrane consisting of 35-mil rubber modified asphalt adhesive laminated to a 5-mil thick, polyolefin film, or match existing.

2.6 ROOF INSULATION

A. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope to match existing.

B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 INSULATION ACCESSORIES

A. General: Provide roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: Match existing.

D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

B. Walkway pads shall be placed around all new roof equipment requiring maintenance, and extend existing walkways to the new areas. Provide walkway pads at roof perimeter adjacent to equipment requiring maintenance.

PART 3 - EXECUTION

3.1 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.2 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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

3.3 PREPARATION

A. Clean substrate of dust, debris, moisture and other substances detrimental to roofing installation according to roofing manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Install insulation strips according to roof deck manufacturer's written instructions.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR-RETARDER INSTALLATION

A. Self-Adhering Vapor Retarder: Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.

1. Extend deck sheet waterproofing to vapor retarders installed on exterior walls to form a continuous barrier.
2. Clean splice areas, applying splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal edges of sheet flashing terminations as recommended by manufacturer.
3. Completely seal vapor retarder at terminations, obstructions and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Install tapered insulation under area of roofing to conform to slopes indicated.

C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

D. Loosely Laid Insulation: Loosely lay insulation units over substrate.

E. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
2. Fasten in pattern to match existing.

3.7 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.

E. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

F. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

G. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.9 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer’s technical personnel to inspect roofing installation on completion.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements or will void the warranty of the existing roof installation.

C. Additional testing and inspecting, at the Contractor’s expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 53 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal flashings.
2. Roof flashings.
3. Copings.

B. Related Sections:

1. Section 02 41 19 “Selective Demolition” for roofing system warranty integrity requirements where existing roofing system is modified or damaged and repaired.
2. Section 07 25 00 “Weather Barriers” for water-resistive air barrier applied over wall sheathing.
3. Section 07 92 00 “Joint Sealants” for elastomeric sealant.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints and seams to provide leakproof, secure and noncorrosive installation.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim showing layout, profile, methods of joining and anchorage details.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required, minimum 0.024 inche (0.6 mm) thick, unless otherwise indicated.

1. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish 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.

2. Color: As selected by Architect from manufacturer's full range.

C. Aluminum-Zinc Alloy-Coated Steel Sheet: prefinished, ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class ASM150 coating designation, Grade 275); structural quality, minimum 24 ga. (0.28 inch) thickness unless otherwise indicated.

1. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish 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.

2. Color: As selected by Architect from manufacturer's full range or match existing.

D. Galvanized Steel Sheet: Galvanized steel sheet, G90, ASTM A527/A653.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Same metal as sheet metal flashing or other non-corrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

H. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

I. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of Work, matching or compatible with material being installed; non-corrosive; size and thickness required for performance.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

E. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, non-corrosive metal recommended by sheet metal manufacturer.
   1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Canopy Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

C. Roof Edge Flashing (Gravel Stop and Coping): Fabricate in minimum 96-inch long, but not exceeding 12-foot long sections. Furnish with 6-inch wide, joint cover plates.
   1. Joint Style: Overlapped, 6 inches wide
   2. Fabricate from the Following Materials:
      a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick (gravel stop)
      b. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick (coping)

D. Expansion-Joint Cover Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch thick (Roof to Wall)
   2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick (Wall to Wall)
   3. hick.

E. Counterflashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

F. Sheet Metal Flashing: not indicated below, Fabricate from the following material:
   1. Prefinished Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A-792 Grade 40.
   2. Thickness: 0.0276 inch (0.7 mm) thick.
   3. Color as selected by Architect.

G. Roof-Penetration and Other Roof Flashing: Fabricate from the following material:
   1. Prefinished Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A-792 Grade 40.
   2. Thickness: 0.0276 inch (0.7 mm) thick.

H. Roof Curbs: Fabricated from the following material:
   1. Prefinished Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A-792 Grade 40.
   2. Thickness: 0.048 inch (1.2 mm)
   3. Insulate roof curb with 1-inch- thick, rigid insulation.

I. Metal Drip Edge: Brake-formed sheet metal with at least a 3-inch roof flange and a 2-inch fascia flange with a 3/8-inch drip at lower edge unless otherwise indicated. Furnish the following material in lengths of 8 or 10 feet (2.5 to 3 m).
   1. Material: Prefinished Aluminum-Zinc Alloy-Coated Steel Sheet.

J. Vent Pipe Flashing: Lead conforming to ASTM B 749, Type L51121, at least 1/16 inch (1.6 mm) thick, unless otherwise indicated. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof extending at least 4 inches (100 mm) from pipe onto roof. Painted color per Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, 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 to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except where pretinned surface would show in finished Work.
   1. Do not solder the following metals: Aluminum.
   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.

E. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
   1. Use joint adhesive for nonmoving joints specified not to be soldered.

F. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

G. Separations: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Seal flashing to equipment support member.

I. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
   1. Install EDPM pipe flashing per manufacturer's recommendations.
   2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07 62 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

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. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits prescribed by joint sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace 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.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
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.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.3 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. 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. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

B. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that 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 in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
2. Remove excess sealant from surfaces adjacent to joints.

3.3 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion-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.

3.4 CLEANING

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

3.5 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 original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

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SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Water Piping.

B. Valves.

C. Backflow Preventers.

1.2 RELATED WORK

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

C. Section 23 05 00 – Common Work Results for HVAC

D. Section 23 07 00 - Piping Insulation.

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be "lead free" in accordance with the Safe Drinking Water Act, Section 1417. "Lead free" materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.

1.4 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include data on pipe materials, pipe fittings, valves and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ASME B16.18, cast copper alloy, or ASME B16.22, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA; Flux: ASTM B813 or Press-Fit.

B. Polypropylene (PP-R) Piping:

1. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in a three layer extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

2. Pipe shall be Aquatherm® Greenpipe®, or Greenpipe® Faser®, available from Aquatherm, Inc.. Piping specifications and ordering information are available at www.aquathermpipe.com.

2.2 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping: 1/16 inch thick preformed neoprene bonded to fiber.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

A. Apollo.

B. Hammond.

C. Milwaukee.

D. Nibco.

E. Substitutions: Under provisions of Division 01.

2.4 GATE VALVES

A. Not permitted. Use ball valves for isolation service.

2.5 GLOBE VALVES

A. Not permitted. Use ball or butterfly valves for throttling service.

2.6 BALL VALVES

A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle, solder, threaded or press-fit ends.

B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle [], flanged, solder, threaded or press-fit ends.

2.7 SWING CHECK VALVES

A. Up to 2 Inches: Bronze swing disc, solder, screwed or press-fit ends.

B. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged, solder, threaded or press-fit ends.

2.8 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, spring loaded, renewable composition disc, wafer, flanged, solder, threaded or press-fit ends.

2.9 PRESSURE RELIEF VALVES

A. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled, NPT ends.

2.10 BALANCE VALVE

A. Straight pattern, calibrated balance valve for 400 psig maximum working pressure, with NSF 61 compliant lead free brass body, type 304 stainless steel ball, glass and carbon filled TFE seat rings, brass and EPT check valves, EPDM stem o-ring, plastic wheel handle for shut-off service,

and lockshield key cap with set screw memory bonnet for balancing service. NPT or sweat ends. Bell & Gossett Circuit Setter Plus or approved equal.

2.11 ACCEPTABLE MANUFACTURERS - BACKFLOW PREVENTERS

A. Watts Regulator.

B. Febco.

C. Colt.

D. Substitutions: Under provisions of Division 01.

2.12 DRAIN VALVES

A. Bronze body, chrome plated brass ball, RPTFE seals and stuffing box ring, stainless steel handle with vinyl cover. 3/4" NPT x 3/4" Hose thread, with duct cover and chain, sweat ends. Apollo 78-100 Series or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

3.3 APPLICATION

A. Install unions downstream of valves and at equipment connections.

B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball or balance valve valves for throttling, bypass, or manual flow control services. (No globe valves permitted.)

3.4 TESTING

A. Test all water piping in accordance with Section 609 of the UPC. Submit a signed statement to the Engineer stating testing dates, procedure and initials of tester.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush, clean and disinfect the potable water system in accordance with Section 609 of the UPC. Submit a signed statement to the Engineer stating disinfection dates, procedure and initials of tester.

END OF SECTION

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.2 WORK INCLUDED

A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.

B. Division 01 of the specifications is to be specifically included as well as all related drawings.

1.3 RELATED WORK

A. Related Work Specified Elsewhere:

1. Electrical Specifications: Division 26.
2. Motors and Connections: Division 26.
3. Starters and Disconnects: Division 26.

B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all mechanical equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electric switches, electrical components, wiring and any other miscellaneous Division 23 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.

C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.4 REFERENCED CODES - LATEST ADOPTED EDITION

A. NFPA 70 National Electrical Code (NEC).

B. IMC International Mechanical Code.

C. UPC Uniform Plumbing Code.

D. IBC International Building Code.

1.5 PROJECT RECORD DRAWINGS

A. In addition to other requirements of Division 01, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.

B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.

C. Show the location of all valves and their appropriate tag identification.

D. At completion of project, deliver these drawings to the Architect and obtain a written receipt.

1.6 SUBMITTALS

A. See General Conditions and the General Requirements in Division 01 regarding submittals.

B. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.

C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.

D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.

E. Submit product data for:

1. Hangers and Supports for HVAC Piping and Equipment.
2. Vibration and Seismic controls for HVAC Piping, Ductwork and Equipment.
3. Identification for HVAC Piping, Ductwork and Equipment.

F. Provide shop drawings with calculations for selection of seismic/wind restraints in accordance with IBC and ASCE 7, certified by a qualified professional engineer, licensed in the State of Alaska. All other components shall utilize an IP of 1.0 for seismic calculations.

1.7 OPERATING AND MAINTENANCE MANUALS

A. Submit maintenance manuals to the Engineer covering all equipment, devices, etc. installed by the Contractor.

B. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be

considered. The Operation and maintenance manuals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications. The manual shall contain, but not limited to, the following types of information:

1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.

2. Catalog cuts of all equipment, etc. installed (Marked to identify the specific items used).

3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.

4. Identification numbers of all parts and nearest sources for obtaining parts and services.

5. Reduced scale drawings of the control system and a verbal description of how these controls operate.

6. A copy of the final test and balance report.

7. A copy of valve schedule and reduced scale drawings showing valve locations.

8. Written summary of instructions to Owner.

9. All manufacturers' warranties and guarantees.

10. Contractors Warranty Letter.

C. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.8 HANDLING

A. See General Conditions and the General Requirements in Division 01 regarding material handling.

B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.9 SUBSTITUTIONS

A. See General Conditions and the General Requirements in Division 01 for substitution request procedures.

B. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of

equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment. The Architect/Engineer shall be the final authority regarding acceptability of substitutes.

1.10 DIMENSIONS

A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

1.11 MANUFACTURER'S DIRECTIONS

A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.12 TERMINOLOGY

A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.

B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.

C. The use of the word "shall" conveys a mandatory condition to the contract.

D. "This section" refers to the section in which the statement occurs.

E. "The project" includes all work in progress during the construction period.

F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.13 SCHEDULE OF WORK

A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.14 COOPERATION AND CLEANING UP

A. The contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.15 WARRANTY

A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warrantied for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Guarantee shall be in accordance with Division 01.

1.16 COMPLETION REQUIREMENTS

A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.

2. Contractors One Year Warranty.

3. All Manufacturers' Guarantees.

4. Test and Balance Reports.

5. Operation and Maintenance Manuals.

1.17 INSPECTION OF SITE - REMODEL PROJECTS

A. The accompanying plans do not indicate completely the existing mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.18 RELOCATION OF EXISTING INSTALLATIONS

A. There are portions of the existing mechanical systems, and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of his particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All equipment shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.

B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.2 RESTRICTED MATERIALS

A. No materials containing asbestos in any form shall be allowed.

B. No solder or flux containing lead shall be used on this project.

C. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.3 ELECTRICAL MOTORS

A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.

B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

C. All motors for use with equipment with variable frequency drives shall be inverter ready motors. Verify compatibility and sizing of motor with variable frequency drive.

D. Size motors for 1.15 service factor and not to exceed 40º C temperature rise above ambient.

E. Fractional horsepower motors to have self-resetting thermal overload switch.

F. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.4 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

A. Plastic Nameplates: Laminated plastic with engraved letters.

B. Plastic Tags: Laminated plastic with engraved letters, minimum 1-1/2 inches diameter.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, for direct burial service.

2.5 PIPE HANGERS AND SUPPORTS

A. Conform to ANSI/MSS SP58.

B. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron, adjustable swivel, split ring for steel pipe, copper swivel for copper pipe.

C. Hangers for Hot Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels or strut with hanger rods.

E. Wall Support for Pipe Sizes to 3 Inches: Strut triangular bracket with pipe clamp and cushion insulator.

F. Vertical Support: Steel riser clamp.

G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with felt isolation pad or all copper ring or swivel.

H. Shield for Insulated Piping 2 Inches and Larger: Hard block calcium silicate insert in 180º segments, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.

I. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield, over insulation in 180º segments, minimum 12 inches long at pipe support.

J. Design hangers to allow installation without disengagement of supported pipe.

K. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe, except hanger rings with factory-applied 1/16 inch minimum thick plastic or tape cushion strip over all contact surfaces.

L. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A 570 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.

2.6 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, or continuous threaded.

2.7 ANCHOR BOLTS

A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.8 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed caulking system.

D. Fire Stopping Insulation: Mineral fiber type, non- combustible.

E. Caulk: Fire stop sealant in compliance with ASTM E814, UL 1479 and Division 07.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 ACCEPTABLE MANUFACTURERS: VIBRATION ISOLATORS AND SEISMIC RESTRAINT

A. Vibration isolators and Seismic Restraint shall be manufactured by:

1. Amber/Booth.

2. Cooper Industries.

3. International Seismic Application Technology.

4. Kinetics Noise Control.

5. Mason Industries.

6. Vibro-Acoustics

B. Substitutions: Items of same function and performance are acceptable in conformance with Division 01.

2.10 VIBRATION ISOLATORS (ROTATING EQUIPMENT EXCEPT FANS)

A. Hangers: Closed spring hanger with acoustic isolator.

B. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

C. Color code spring mounts, spring selected to operate at no greater than 2/3 solid deflection and have ¼" ribbed neoprene pads.

2.11 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.

2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.

3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.

4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.

5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.12 SEISMIC BRACING COMPONENTS

A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.

1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.

2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.

3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.

4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS. Gr.33.

5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

PART 3 - EXECUTION

3.1 DRAWINGS

A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping and ducts, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.2 INSTALLATION

A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NFPA, and IECC Standards; all local and state amendments to all codes and standards.

B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.

C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

A. Verify all measurements on the job site.

B. Locate all equipment on the centers of walls, openings, spaces, etc., unless specified otherwise.

C. Check all piping, ducts, etc. to clear openings.

D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.4 OPERATING INSTRUCTIONS

A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Mechanical Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.

B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of four hours of on site instruction to the owner designated personnel.

C. When required by individual specification sections provide additional training on HVAC systems and equipment as indicated in the respective specification section.

D. Provide schedule for training activities for review prior to start of training.

3.5 SYSTEM ADJUSTING

A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all controls, noise and vibration.

B. Balance water systems for volume quantities shown and as required to ensure even temperature. Balancing shall be done by a qualified firm acceptable to the Engineer. Provide balancing log to the Engineer before substantial completion.

3.6 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.

C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.7 PAINTING

A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of mechanical work:

1. Factory applied prime and finish coats on mechanical equipment.

2. Factory applied prime and finish coat on all air registers, grilles and diffusers, unless otherwise specified.

3. Factory applied prime coat on access doors.

4. Pipe identification where specified.

B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.8 IDENTIFICATION

A. Tag all valves with heat resistant laminated plastic labels or brass tags engraved with readily legible letters. Securely fasten to the valve stem or bonnet with beaded chain. Provide a framed, typewritten directory under glass, and installed where directed. Provide complete record drawings that show all valves with their appropriate label. Seton 250-BL-G, or 2961.20-G, 2” round or equal.

B. Label all equipment with heat resistant laminated plastic labels having engraved lettering ½" high. If items are not specifically listed on the schedules, consult the Engineer concerning designation to use. Seton engraved Seton-Ply nameplates or equal.

C. Identify piping to indicate contents and flow direction of each pipe exposed to view by a labeled sleeve in letters readable from floor at least once in each room and at intervals of not more that 20' apart and on each side of partition penetrations. Coloring scheme in accordance with ANSI A13.1-1981, Seton Opti-Code or equal.

3.9 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
½ to 1-¼ inch	6'-0"	3/8"
1-½ to 2 inch	10'-0"	3/8"
2-½ o 3 inch	10'-0"	½"
PVC (All Sizes)	4'-0"	3/8"

B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-½ 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 the same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide transverse seismic support for all piping systems.

J. Support all piping on flat roofs using rooftop pipe supports. pillow block supports. Install per manufacturer's instructions. Install piping minimum 6" above roof surface.

3.10 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

E. 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.

3.11 EQUIPMENT SUPPORTS

A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

B. Construct support of steel members. Brace and fasten with flanges bolted to structure.

C. Provide rigid anchors for pipes after vibration isolation components are installed.

D. Anchor (Expansion) Bolts: Install anchor bolts for all mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at all equipment support points. Provide locknuts where equipment, piping, and ductwork is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or to anchor stationary equipment from existing concrete slabs.

3.12 FLASHING

A. Provide flexible flashing and metal counter-flashing where piping penetrate weather or waterproofed walls, floors, and roofs.

3.13 SLEEVES

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Set sleeves in position in construction. Provide reinforcing around sleeves.

C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.

D. Where piping penetrates floor, ceiling, or wall, install sleeve, close off space between pipe and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where fire rated walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.14 SCOPE OF VIBRATION ISOLATION WORK

A. All vibrating equipment and the interconnecting pipe shall be isolated to eliminate the transmission of objectionable noise and vibration from the structure.

B. All installed rotating equipment with excessive noise and/or vibration, which cannot be corrected in place, shall be replaced at no cost to Owner.

3.15 GENERAL PROCEDURES – VIBRATION ISOLATION

A. Select isolators in accordance with the manufacturer's recommendations and the equipment weight distribution to allow for proper static deflection of the isolators in relation to the span of the building structure supporting the equipment, considering the allowable deflection and weight of the structure.

B. Install isolators so they can be easily removed for replacement.

C. Mount all equipment absolutely level.

D. Install all isolators per manufacturer's instructions.

E. Install vibration isolators for mechanical motor driven equipment.

F. Set steel bases for 1" clearance between housekeeping pad and base.

G. All vibration isolated equipment shall be fitted with earthquake bracing and snubbers suitable for seismic control in accordance with the IBC.

H. Piping vibration isolation flexible connections shall be installed at a 90° angle to equipment deflection direction unless otherwise noted.

3.16 SEISMIC RESTRAINT

A. General:

1. All equipment, piping and ductwork shall be restrained to resist seismic/wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations. Additional requirements specified herein are included specifically for this project.

2. Install seismic and wind restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

3. Attachment to structure for suspended equipment, pipe and duct: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.

5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.

6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

7. Where rigid restraints are used on equipment, ductwork or piping, support rods for the equipment, ductwork or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.

8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Concrete Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

C. Equipment Restraints:

1. Seismically restrain equipment all equipment. Install fasteners, straps and brackets as required to secure the equipment.

2. Install seismic snubbers on HVAC equipment supported by floor-mounted, non-seismic vibration isolators. Locate snubbers as close as possible to vibration isolators and attach to equipment base and supporting structure as required.

3. Install neoprene grommet washers on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 1/8" (3.2 mm).

4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Piping Systems:

E. For projects with a Seismic Design Category of D, provide seismic cable restraints on the following:

1. All piping systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 2" (50 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).

F. For projects with a Seismic Design Category of D, provide seismic cable restraints on the following:

1. All piping greater than 3" (75 mm) nominal diameter.

2. All piping systems assigned a component importance factor, Ip, of 1.5 with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).

G. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:

1. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.

2. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.

H. Restraint spacing:

1. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.

2. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

3. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.

4. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.

I. Brace a change of direction longer than 12' (3.7 m).

J. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.

K. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.

L. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.

M. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

N. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.

O. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

P. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

3.17 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacture recommended minimum clearances for access and maintenance.

C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.

D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.

F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure Gauges.
2. Pressure Gauge Taps.
3. Thermometers.
4. Balance Valves.

B. PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THE SECTION

1. Section 23 21 13 - Hydronic Piping: Installation of thermometer wells, pressure gauge tappings, balance valves, etc.

1.2 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.

C. Section 23 21 13 - Hydronic Piping.

D. Section 23 56 16 – Solar Thermal Collectors.

1.3 REFERENCE STANDARDS

A. ASTM E1 - Specification for ASTM Thermometers.

B. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.

C. ASTM E1 - Standard Specification for ASTM Thermometers.

1.4 SUBMITTALS

A. Product Data: Submit engineering data for each component, Include list which indicates use, operating range, total range and location for manufactured components.

B. Submit manufacturer's installation instructions under provisions of Division 01.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual location of all instrumentation and gauges.

B. Operation and Maintenance Data.

1.6 WARRANTY

A. Furnish one year manufacturer warranty for HVAC instrumentation.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION FOR HVAC

A. Manufacturers:

1. Dwyer
2. Trerice.
3. Weiss.
4. Marshaltown.
5. Ashcroft.
6. Enerpac.
7. Peterson.
8. Substitutions: In accordance with Division 01.

2.2 PRESSURE GAUGES

A. 4-1/2 inch diameter cast aluminum case, phosphor bronze bourbon tube, rotary bronze movement, brass socket, [with silicone fluid dampening] black figures on white background, one percent mid-scale accuracy, scale calibrated in psi. Model 600CB as manufactured by Trerice or approved equal.

2.3 PRESSURE GAUGE TAPS

A. Gauge Isolation Valve: Lever handle ball valve, forged brass body, chrome plated brass ball, viton o-rings for maximum 150 psig. Model Mini T-82-M as manufactured by Jomar or equal.

B. Needle Valve: Brass for maximum 150 psig. Model 735 as manufactured by Trerice or equal.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections. Series 870 as manufactured by Trerice.

D. Coil Siphon: Brass, ¼", male pipe thread each end. 885 series.

2.4 BALANCE VALVES WITH FLOW INDICATION

A. The balance valve shall be constructed of brass suitable for use in potable water systems with high resistance elastomer seals.

B. The balance valve shall provide an integral visual flow meter housed in a by-pass circuit on the valve body that can be shut off during normal operation. The valve body shall be equipped with a preformed insulated shell.

2.5 ACCEPTED MANUFACTURES – BALANCE VALVES WITH FLOW INDICATION

A. Caleffi – 258 Series

B. Substitutions as approved by Engineer and Owner.

2.6 STEM TYPE THERMOMETERS

A. Analog Thermometers: 9 inch scale, universal adjustable angle, red appearing mercury, lens front tube, cast aluminum case with blueblack metallic finish and clear Lexan window, extended brass stem, cast aluminum adjustable joint with positive locking device, 2 percent of scale accuracy to ASTM E77, scale calibrated in both degrees F and degrees C, range per schedule. BX9 series as manufactured by Trerice or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide a single pressure gauge per pump, installing taps on suction and discharge of pump. Pipe to gauge with isolation valve to each tapping.

C. Install thermometers in piping systems in sockets in short couplings Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Select bulb length to reach centerline of pipe. Coat thermometer stem with conductive compound.

D. Install thermometer sockets and flanges adjacent to controls system thermostat, transmitter, or sensors. Refer to Section 23 09 23.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install gauges and thermometers in locations where they are easily read from normal operating level.

3.2 PRESSURE GAUGE SCHEDULE

LOCATION	SCALE RANGE
Pumps less than 40' TDH	0 - 30 PSIG
Pumps more than 40' TDH	0 - 60 PSIG
Heating water system	0 - 30 PSIG
Glycol water system	0 - 30 PSIG
Others	As applicable

3.3 THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Heating water system	0 - 200° F
Glycol water system	0 - 200° F
Others	As applicable

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Hydronic Systems:

1. Constant Flow Systems.
2. Variable Flow Systems.

1.2 SCOPE

A. Furnish the professional services of a qualified and approved balancing and testing firm to perform the work of this specification section.

B. The work of this section includes but is not necessarily limited to:

1. Testing and balancing new liquid heat transfer systems.
2. Working directly with the control subcontractor to obtain proper system adjustments.

C. The work of this section does not include:

1. Adjusting burners for proper combustion operation.
2. Liquid waste transfer system adjustment.
3. Fire protection systems.

1.3 APPLICABLE CODES AND STANDARDS

A. SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems.

B. AMCA Publication 203, Field Performance Measurements.

C. American Air Balancing Council (AABC) Recommended Procedures.

D. National Environmental Balancing Bureau (NEBB) Recommended Procedures.

1.4 QUALIFICATION OF THE BALANCING FIRM OR COMPANY

A. Subcontractor minimum qualifications include:

1. Demonstrate satisfactory completion of five projects of similar scope in the State of Alaska during the past five years. Provide references if requested.

2. NEBB Certified in Testing, Adjusting and Balancing of Air and Hydronic Systems.

1.5 TIMING OF WORK

A. Do not begin balancing and testing until the systems, including controls, are completed and in full working order.

B. Schedule the testing and balancing work in cooperation with other trades.

C. Complete the testing and balancing at least one week before the date of substantial completion and before any occupancy occurs.

1.6 CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

A. Award the test and balance contract to an approved firm or company upon receipt of contract to allow the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.

B. Put all heating, ventilating and air conditioning systems, equipment and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing balancing.

C. Provide scaffolding, ladders and access to each system for proper testing balancing.

D. Ensure that the building enclosure is complete, including but not limited to, structural components, windows and doors installed, door hardware complete, ceilings complete, stair, elevator and mechanical shafts complete, roof systems complete, all plenums sealed, etc.

E. Make any changes in pulleys, belts and dampers, or add any dampers as required for correct balance as recommended by the Balance and Testing Agency at no additional cost to the Owner.

F. Complete installation, programming (including design parameters and graphics), calibration, and startup of all building control systems.

G. Require that the building control system firm provide access to hardware and software, or onsite technical support required to assist the TAB effort. The hardware and software or the onsite technical support shall be provided at no cost to the TAB firm.

1.7 REPORT

A. Certified Reports shall be included in project O & M manuals. Reports shall include: testing, adjusting, and balancing reports bearing the signature of the Test and Balance Agency Representative. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the system. Follow the procedures and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports.

2. Final Reports: Upon verification and approval of the draft report; prepare final reports, typewritten, organized and formatted as specified below.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the documents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

   a. General Information and Summary.

   b. Air Systems.

   c. Hydronic Systems.

   d. Temperature Control Systems.

   e. Special Systems.

   f. System Deficiency Reports and Corrective Actions.

4. Report Contents: Provide the following minimum information, forms and data:

   a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency; contractor; owner, architect, engineer and project. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the name, address, telephone number and signature of the Certified Test and Balance Personnel. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.

   b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the

AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.8 SUBMITTALS

A. Submit in accordance with Division 01.

B. Submit balancing agency qualifications and sample balancing forms.

C. Provide list of equipment to be used and date of last calibration.

D. Submit preliminary balance report a minimum of one week prior to balancing system.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics.

1. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.

2. Static Pressure Instruments: Direct reading in inches water gauge, 2% accuracy.

3. RPM Instruments: Direct reading in revolutions per minute, .5% accuracy; or revolution counter accurate within 2 counts per 1,000.

4. Pressure Readout: Direct reading in feet of water or PSI, .5% accuracy.

5. Temperature Instruments - Direct reading in degrees F, +.5% accuracy.

6. Water Flow Instruments: Differential pressure type; direct reading in feet of water or PSI, accuracy, suitable for readout balancing valve provided.

7. Sound Measuring Instrument: Octave Band Analyzer which essentially complies to AASA Standards SI.6 1960 with a range of 24DB to 150 DB sound pressure level ref. .0002 microbar. Calibrate sound test instrument before use to a closed coupler and a driving loudspeaker that produces a know-sound pressure level at the microphone of the analyzer.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES FOR ALL SYSTEMS

A. Start with new, clean filters.

B. In cooperation with the control manufacturer's representative, coordinate adjustments of automatically operated dampers and valves to operate as specified, indicated and/or noted.

C. Use manufacturer's ratings on all equipment to make required calculations.

D. Make final adjustments for each space per heating or cooling comfort requirement. State reason for variance from design CFM, i.e., "too noisy", "drafty", etc.

E. Mark equipment and balancing device settings (including damper-control positions, valve position indicators, fan-speed-controls, and similar controls and devices) with paint or other suitable permanent identification material to show final settings.

3.2 FLUID SYSTEM TESTING AND BALANCING

A. Preparation of system - Phase I:

1. Complete air balance before beginning fluid balance.

2. Clean all strainers.

3. Examine fluid in system to determine if treated and clean.

4. Check pump rotation.

5. Verify expansion tanks are not air bound and system full of fluid.

6. Verify all air vents at high points of fluid systems are installed properly and are operating freely. Make certain all air is removed from circuiting system.

7. Open all valves to full flow position including coil and heater stop valves, close bypass valves and open return line balancing cocks. Set temperature controls so that automatic valves are open to full flow through apparatus.

8. Check and set operating temperature of boilers and heat exchangers to design requirements when balancing by temperature drop.

9. Adjust all flows to 110% of design flows as shown.

B. Test and Balance Procedure - Phase II:

1. Set pumps to proper GPM delivery and set proper GPM delivery in main piping runs from boiler room. Note flow variations for additive alternates.

2. Adjust flow of fluid through primary equipment.

3. Check leaving fluid temperatures and return fluid temperatures and pressure drop through major equipment. Reset to correct design temperatures.

4. Check fluid temperature at inlet side of coils and other heat transfer equipment. Note rise or drop of temperatures from source.

5. Balance each coil and all other heat transfer apparatus in system.

6. Upon completion of flow readings and adjustments, mark all settings and record all data.

C. Test and Balance Procedure - Phase III:

1. After making adjustments to coils and apparatus, recheck settings at pumps and major equipment. Readjust if required.

2. Attach pressure gauges on each coil, then read pressure drop through coil at set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop. This prevents unbalanced flow conditions when coils are on full bypass.

3. Check and record the following items with flows set at 100% of design.

   a. Inlet and leaving fluid and air temperatures at coils and major equipment.

   b. GPM flow of each coil and major equipment.

   c. Pressure drop of each coil and major equipment.

   d. Pressure drop across bypass valve.

   e. Pump operating suction and discharge pressures and final total developed head.

   f. Pump GPM.

   g. Rated and actual running amperage and voltage of pump motor.

   h. Full nameplate data of all pumps and equipment.

   i. Electrical overloads/heaters sizes and ranges of motors.

4. Permanently mark adjusted position of all balancing valves. Stamp indicator plate of circuit setters and other balancing valves without memory stop.

END OF SECTION

SECTION 23 07 00 - PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Piping Insulation.

B. Jackets and Accessories.

1.2 RELATED WORK

A. Division 09 - Painting: Painting Insulation Jacket.

1.3 REFERENCES

A. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

C. ANSI/ASTM C547 - Mineral Fiber Pre-formed Pipe Insulation.

D. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

E. ANSI/ASTM C578 - Pre-formed, Block Type Cellular Polystyrene Thermal Insulation.

F. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.

G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

H. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.

I. ASTM E84 - Surface Burning Characteristics of Building Materials.

J. NFPA 255 - Surface Burning Characteristics of Building Materials.

K. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with three years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723.

1.5 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include product description, thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Armstrong.

B. Certain Teed.

C. IMCOA.

D. Knauf.

E. Owens - Corning.

F. Pittsburgh - Corning.

G. Schuller.

H. TCI Products.

I. Substitutions: Under provisions of Division 01.

2.2 INSULATION

A. Type A: Glass fiber insulation; ANSI/ASTM C547 (Class 1); 'k' value of 0.24 at 75º F, noncombustible, rated to 450° F, Schuller "Micro-Lok" or equal.

B. Type G: Elastomeric foam; flexible, ANSI/ASTM C534 (Type I); 'k' value of 0.27 at 75° F. Armstrong “Armaflex” or equal.

C. Type J: Flexible unicellular polyolefin; ASTM C534; 'k' value of 0.24 at 75º F ASTM C518; moisture vapor transmission of zero perm-inch ASTM E96; rated to 210º F; IMCOA “Imcolock” or equal.

2.3 JACKETS

A. Interior Applications:

1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.

2. PVC Jackets: One piece, premolded type.

B. Exterior Applications:

1. Aluminum Jackets: ASTM B209; 0.02 inch thick; corrugated or textured finish.

2. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; corrugated finish.

2.4 ACCESSORIES

A. Insulation Bands: ¾ inch wide; 0.015 inch thick galvanized steel.

B. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.

D. Finishing Cement: ASTM C449. Type “G”: Armaflex finish.

E. Fibrous Glass Cloth: Untreated; 9 oz/sq. yd weight.

F. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install materials after piping has been tested and approved.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Continue insulation with vapor barrier through penetrations.

C. In exposed piping, locate insulation and cover seams in least visible locations.

D. Do not insulate flanges and unions at equipment on piping conveying fluids above ambient temperature, but bevel and seal ends of insulation at such locations.

E. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

F. Neatly finish insulation at supports, protrusions, and interruptions.

G. Jackets:

1. Indoor, Concealed Applications: Insulated pipes shall have vapor barrier jackets, factory-applied. Vapor barrier PVC fittings may also be used provided joints are sealed with Schuller "Perma Weld" or equal.

2. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with jacket; size for finish painting.

3. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum or stainless steel jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.

H. Insulate all exposed trap arms, drains, and hot water supplies for handicap protection on handicap accessible fixtures.

3.3 SCHEDULE

PIPING	TYPE	PIPE SIZE Inch	INSULATION THICKNESS Inch
Domestic Cold Water	A, J	All Sizes	1" [1/2”]
Domestic Hot Water Supply	A, J	All Sizes	1" [1/2”]
Domestic Hot Water Recirculating	A, J	All Sizes	1" [1/2”]
Piping Exposed to Freezing	G, J	All Sizes	2"

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Pipe and Pipe Fittings.

B. Valves.

C. Heating Water Piping System.

1.2 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 19 – Meters and Gages for HVAC Piping.

C. Section 23 21 23 - Hydronic Pumps.

D. Section 23 56 16 - Solar Thermal Collectors.

1.3 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

1.4 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.5 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Include data on pipe materials, pipe fittings, valves, and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ANSI/ASME B16.18 cast bronze of ANSI/ASME B16.29 solder wrought copper.

2. Joints: ASTM B32, solder, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.

3. Press Fittings: Viega ProPress Fittings are allowed. Sealing elements for press fittings shall be EPDM.Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have Smart Connect feature design leakage path. Smart Connect™ (SC Feature) In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

B. Polypropylene Pipe:

1. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hydronic hot water and heating piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

2. Fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

3. Pipe shall be Aquatherm® Green Pipe® MF® or Blue Pipe® MF®, available from Aquatherm, NA.

4. Installation of Polypropylene piping in return air plenums is prohibited.

C. Grooved piping systems are not allowed.

2.2 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.

2.3 GATE VALVES

A. Gate valves will not be permitted. Use ball or butterfly valves for isolation.

2.4 GLOBE VALVES

A. Globe valves will not be permitted. Use ball or butterfly valves for throttling.

2.5 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

A. Milwaukee.

B. Nibco.

C. Crane.

D. Hammond.

E. Substitutions: Under provisions of Division 01.

2.6 BALL VALVES

A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle , solder or threaded ends

B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged. Seat material to be compatible with liquid handled.

2.7 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45º swing disc, solder ends.

2.8 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

2.9 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 00.

E. Provide clearance for installation of insulation, and access to valves and fittings.

F. Provide access where valves and fittings are not exposed.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain bottom of pipe level.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09.

J. Install valves with stems upright or horizontal, not inverted.

K. Fusion Welding of Joints for Polypropylene Piping:

1. Install fittings and joints using socket-fusion, elecrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.

2. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.

3. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer's specifications.

4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

3.3 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball or butterfly valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of condenser water pumps.

G. Provide ¾ inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.

3.4 CLEANING OF THE HYDRONIC SYSTEM

A. Prior to starting work, verify system is complete. Thoroughly flush, drain and refill system.

B. Flush, clean and disinfect the potable water system in accordance with Section 609 of the UPC. Submit a signed statement to the Engineer stating disinfection dates, procedure and initials of tester.

C. Completely flush system and drain all low points. Remove, clean and reinstall strainer baskets.

D. Fill system with water. Feed water to system through make-up line with pressure regulator, venting system high points.

E. Submit a written and signed statement to the Owner that the above referenced cleaning procedures have been completed.

END OF SECTION

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SECTION 23 21 23 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. In-line Circulators.

1.2 RELATED WORK

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 23 05 19 – Meters and Gages for HVAC Piping.

C. Section 23 21 13 - Hydronic Piping.

1.3 REFERENCES

A. ANSI/UL 778 - Motor Operated Water Pumps.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years' experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.

1.5 SUBMITTALS

A. Submit product data under provisions of Division 01.

B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Grundfos.

B. Substitutions: Under provisions of Division 01.

2.2 GENERAL CONSTRUCTION REQUIREMENTS

A. Balance: Rotating parts, statically and dynamically.

B. Construction: To permit servicing without breaking piping or motor connections.

2.3 IN-LINE CIRCULATORS

A. Type: Maintenance free, self-lubricated, direct drive circulator, suitable for use in open/potable water systems.

B. Casing: Stainless Steel.

C. Impeller: stainless steel or PES 30%GF.

D. Bearings: Upper and lower radial bearings to be aluminum oxide ceramic, tungsten carbide shaft bearing surfaces.

E. Shaft: Stainless steel with type 430F.

F. Variable Speed: Pump shall accept either 0-10 VDC or PWM speed reference signal. Speed controls to be integral to pump. Remote VFD not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. 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.

D. Decrease from line size with long radius reducing elbows or reducers.

E. Support piping adjacent to pump such that no weight is carried on pump casings. In-line pumps are supported by adjacent piping.

F. Provide air cock and drain connection on horizontal pump casings.

G. Provide drains for bases and seals, piped to and discharging into floor drains.

H. Lubricate pumps before start-up.

END OF SECTION

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SECTION 23 56 13 - SOLAR THERMAL COLLECTORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Solar Hot Water Collectors.

B. Solar Controls.

C. Solar Pumps.

D. Solar Hot Water Storage Tank.

E. Btu meter

1.2 RELATED WORK

A. Section 23 05 00 – Common Work Results for HVAC

1.3 SUBMITTALS

A. Shop Drawings: Indicate manufactured assembly's system and control schematics, solar collector installation, layout, weights, mounting and support details, and piping connections.

B. Product Data: Submit data on specialties, including manufacturers catalog information. Indicate chemical treatment materials, chemicals, and equipment. Submit certified pump performance and NPSH curve. Submit performance ratings for solar collectors, rough-in details.

C. Manufacturer's Installation Instructions: Submit mounting and other structural requirements.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Field-Reports: Indicate start-up of treatment systems and include analysis of system water after cleaning and treatment.

1.4 CLOSEOUT SUBMITTALS

A. Execution Requirements: Closeout procedures.

B. Operation and Maintenance Data: Spare parts lists, procedures, and treatment programs.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Code standard.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum two years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.7 PRE-INSTALLATION MEETING

A. Administrative Requirements: Pre-installation meeting.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Product Requirements: Product storage and handling requirements.

B. Accept and store solar collectors and valves in shipping containers and maintain in place until installation.

C. Protect piping from debris and other foreign matter by using caps on piping connections.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Execution Requirements: Product warranties and product bonds.

B. Provide ten (10) year manufacturer warranty for solar collectors and solar storage tanks.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - SOLAR COLLECTORS

A. HTP -Solar Skies.

B. Substitutions: As approved by Engineer and Owner.

2.2 SOLAR HOT WATER COLLECTORS

A. The collector construction shall consist of an aluminum frame with low-iron tempered glass and UV durable EPDM channel with molded corners to prevent all water penetration. Collector must be certified to withstand up to 181 MPH wind load.

B. Each collector glass face shall be constructed of High-T tempered glass with an iron oxide content of less than 1% and have a total solar energy transmission of greater than 91%. The glass face shall have a selective crystal clear coating with $\alpha \approx 0.945 - 0.965$ and $\varepsilon \approx 0.06 - 0.09$.

C. The collectors shall be designed for operating at: minimum angle of inclination 0 degrees, maximum angle of inclination 90 degrees;

D. The collector shall consist of absorbers constructed of copper and having a homogeneous forge Thermafin weld between the fins and the risers.

2.3 ACCEPTABLE MANUFACTURERS - SOLAR CONTROLS

A. Manufacturers:

1. Campbell Scientific – CR6, The solar controls shall be a complete package provided by the solar collector manufacturer.

2. Substitutions: As approved by Engineer and Owner.

2.4 SOLAR CONTROLLERS

A. The controller shall be guaranteed to meet electrical specifications in temperatures from -40 to +70 degree C.

B. The controller shall have a minimum of 12 universal inputs that can be configured to read resistive, voltage, current and PWM signals.

C. The controller shall have analog outputs to provide voltage, current and PWM signals. Provide outputs needed for a complete system with a minimum of 1.20% x used outputs for spares.

D. The controller shall be fully programmable with non-volatile memory capable of solar heating algorithms and BTU calculations.

E. The controller shall provide communications ports: RJ45/ jack 10/100Base-TX, USB, RS-232 and RS-485.

F. The controller shall act as a WEB server for user interface.

G. The controller shall communicate through standard Ethernet protocols and Modbus.

H. The controller shall have a minimum 3 year warranty.

2.5 SOLAR STORAGE TANKS

A. The solar hot water storage tank shall be rated for storage of water at 180 degree Fahrenheit.

B. The solar hot water storage tank shall have an overall thermal resistance of R-30.

C. The integral heat exchangers shall be constructed of potable grade 316 stainless steel 1" or 1-¼" corrugated steel tubing, 100 feet in length.

D. The solar hot water storage tank shall have a structural aluminum frame and have a safety factor rating of 3+.

2.6 ACCEPTABLE MANUFACTURERS – SOLAR STORAGE TANKS

A. Cocoon Tanks, LLC

B. Substitutions: As approved by Engineer and Owner.

2.7 FLOW METERS

A. Inline ultrasonic flow meter.

B. NIST calibration

C. Constructed of materials suitable for open systems and potable water.

2.8 ACCEPTABLE MANUFACTURERS – FLOW METERS

A. Onicon – F4600 Series

B. Substitutions: As approved by Engineer and Owner.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install per manufacturers direction.

END OF SECTION

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General Requirements specifically applicable to Division 26, in addition to Division 01 provisions.

B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.2 WORK SEQUENCE

A. Construct Work in sequence under provisions of Division 01.

1.3 COORDINATION

A. Coordinate the Work specified in this Division under provisions of Division 01.

B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.4 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.

B. NECA - Standard of Installation.

C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.

E. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Structural, and Mechanical Drawings and adjust work to conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 70.

B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.

C. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.6 SUBMITTALS

A. Submit inspection and permit certificates under provisions of Division 01.

B. Include certificate of final inspection and acceptance from authority having jurisdiction.

C. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation is the sole responsibility of the Contractor.

D. In addition to requirements referenced in Division 01, the following is required for work provided under this division of the specification.

1. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.

2. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein. Separate from work furnished under other divisions. Index and clearly identify all material and equipment by item, name or designation used on drawings and in specifications.

3. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.

4. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

5. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.

6. Coordinate submittals with requirements of work and of Contract Documents.

7. Certify in writing that the submitted shop drawings and product data are in compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.

8. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.

9. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.

10. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.

1.7 SUBSTITUTIONS

A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.8 PROJECT RECORD DRAWINGS

A. Maintain project record drawings in accordance with Division 01.

B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.

C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner’s Representative at all times.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in Division 01, the following is required for work provided under this section of the specifications.

B. Manuals shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.

C. Unless otherwise noted in Division 01, provide one copy of all material for approval.

D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.

1. List chapters of information comprising the text. The following is a typical Table of Contents:

a. Electrical power distribution.

2. Provide the following items in sequence for each chapter shown in Table of Contents:

a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.

1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.

2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.

3) Include test results of all tests required by this and other sections of the specifications.

b. Maintenance Instructions:

1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:

a) Distribution equipment.

2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.

3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.

4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.

5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each part by part number and manufacturer.

1.10 DEMONSTRATION OF ELECTRICAL SYSTEMS

A. During substantial completion inspection:

1. Conduct operating test for approval under provisions of Division 01.

2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.

3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.

4. Have instruments available for measuring voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.

5. Provide personnel to assist in taking measurements and making tests.

1.11 WARRANTY

A. In addition to the requirements of Division 01, or as specified in other sections. Warrant all materials, installation and workmanship for one (1) year from date of acceptance.

B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.12 INSTRUCTION OF OPERATING PERSONNEL

A. In accordance with the requirements of Division 01 and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.

B. Certify that an Anchorage, or Wasilla based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.

C. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All Materials and Equipment shall be new.

B. All Materials and Equipment shall be listed by Underwriter's Laboratories or equivalent third party listing agency for the use intended.

C. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.

D. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.

E. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.2 TESTS

A. Notify the Owner’s representative at least 72 hours prior to conducting any tests.

B. Perform additional tests required under other sections of these specifications.

C. Perform all tests in the presence of the Owner's representative.

D. The Contractor shall provide written notification to the Owner's representative and the State Electrical Inspector thirty days in advance of requests for rough-in and substantial completion inspections.

3.3 PENETRATIONS OF FIRE BARRIERS

A. Related information to this section appears in Division 07, Fire Stopping.

B. All holes or voids created to extend electrical systems through fire rated floors, walls or ceiling shall be sealed with an asbestos-free intumescent fire stopping material capable of expanding 8 to 10 times when exposed to temperatures 250ºF or higher.

C. Materials shall be suitable for the fire stopping of penetrations made by steel, glass, plastic and shall be capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814 and UL 1479.

D. The rating of the fire stops shall be the same as the time-rated floor, wall or ceiling assembly.

E. Install fire stopping materials in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 26 05 03 - EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electrical connections to equipment specified under other Sections.

1.2 RELATED WORK

A. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

D. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCES

A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.

B. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Purpose Wiring Devices.

2. NEMA WD 5 - Specific-Purpose Wiring Devices.

1.4 COORDINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Straight-blade Attachment Plug: NEMA WD 1.

B. Locking-blade Attachment Plug: NEMA WD 5.

C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

D. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.

E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

B. Make conduit connections to equipment that is subject to vibration or movement using flexible conduit. Use Liquidtight flexible conduit in damp or wet locations.

C. Install pre-finished cord set where connection with attachment plug is indicated or specified by the equipment manufacturer's installation instructions, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where required.

F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches and connect with conduit and wiring as indicated in the equipment manufacturer's installation instructions.

3.4 ADJUSTING

A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

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SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building Wire.

B. Wiring Connections and Terminations.

1.2 RELATED SECTIONS

A. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

A. Federal Specification FS-A-A59544 – Cable and Wire, Electrical (Power, Fixed Installation).

B. ANSI/NEMA WC 70-2009 – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

C. NETA ATS – Acceptance testing specifications for Electrical Power Distribution and Systems.

D. NFPA 70 – National Electrical Code.

E. NFPA 262 – Standard Method of test for flame travel and smoke of wires and cables for use in air-handling spaces.

F. UL 62 – Flexible Cords and Cables.

G. UL 83 – Thermoplastic Insulated Wire and Cable.

H. UL 1479 – Standard for Fire Tests of Through Wall Penetration Fire Stops.

I. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.4 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Thermoplastic-insulated Building Wire: NEMA WC 5.

B. Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN or XHHW-2. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor.

C. Branch Circuit Wire Color Code:

1. Color code wires by line or phase as follows:

a. Black, red, blue and white for 120/208V systems.

2. For conductors 6 AWG and smaller, insulation shall be colored.

3. Grounding conductors 6 AWG and smaller shall have green colored insulation.

D. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 90º C, individual conductors twisted together, shielded, and covered with an overall PVC jacket; UL listed.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90º C, individual conductors twisted together, shielded or unshielded (as required), and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90º C, individual conductors twisted together, shielded or unshielded (as required), and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 WIRING CONNECTIONS AND TERMINATIONS

A. For conductors 8 AWG and smaller:

1. Dry interior areas: Spring wire connectors, pre-insulated “twist-on” rated 105 degrees C per UL 468C. Where stranded conductors are terminated on screw type terminals, install crimp insulated fork or ring terminals. Thomas & Betts Sta-Kon or equal.

2. Motor connections: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.

3. Wet or exterior: Spring wire connectors, pre-insulated "twist-on", resin filled rated for direct burial per UL 486D.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power circuits, and no smaller than 18 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet.

C. Splice only in junction or outlet boxes.

D. Neatly train and lace wiring inside boxes, equipment, and panelboards.

E. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Verify that raceway is complete and properly supported prior to pulling conductors.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Do not install XHHW-2 conductors when ambient temperatures are below –5 degrees C and THHN/THWN conductors when ambient temperatures are below 0 degrees C.

D. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.

E. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

F. Route conductors from each system in independent raceway system and not intermix in the same raceway, enclosure, junction box, wireway, or gutter as another system unless otherwise shown on the plans.

G. Completely and thoroughly swab raceway system before installing conductors.

H. When two or more neutrals are installed in one conduit, identify each with the proper circuit number in accordance with Section 26 05 53.

3.3 WIRING CONNECTIONS AND TERMINATIONS

A. Stranded wire shall not be wrapped around screw terminals.

B. Splice only in accessible junction boxes.

C. Thoroughly clean wires before installing lugs and connectors.

D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

E. Terminate spare conductors with twist on connectors or heat shrink insulation to proper voltage rating.

F. Control systems wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.

G. Do not exceed manufacturer's recommended pull tensions.

3.4 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 01.

B. Inspect wire and cable for physical damage and proper connection.

C. Torque conductor connections and terminations to manufacturer's recommended values.

3.5 WIRE AND CABLE INSTALLATION SCHEDULE

A. All Locations: Building wire and/or remote control and signal cable in raceways.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical Equipment and Raceway Grounding and Bonding.

1.2 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

1.3 REFERENCE STANDARDS

A. ANSI/NFPA 70 – National Electrical Code.

B. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.

C. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.

D. UL 467 – Standard for Grounding and Bonding Equipment.

1.4 SYSTEM DESCRIPTION

A. Provide a complete grounding system for services and equipment as required by State and Local Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter. Stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors may be insulated conductors if used provide green insulation.

B. Grounding Conductors: Copper conductor bare or green insulated.

C. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide a separate, insulated equipment-grounding conductor in all new branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.

B. Bond together system neutrals, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables.

C. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.

D. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.

3.2 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDED

A. Conduit Supports.

B. Formed Steel Channel.

C. Spring Steel Clips.

D. Sleeves.

E. Mechanical Sleeve Seals.

1.2 RELATED WORK

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCES

A. International Building Code (IBC), Chapter 16 – Structural Design.

1.4 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.

2. Minerallac Fastening Systems.

3. O-Z Gedney Co.

4. Substitutions: per Division 01

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. self-locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. B-Line Systems.

2. Allied Tube & Conduit Corp.

3. Unistrut Corp.

4. Substitutions: per Division 01.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Sleeves Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Obtain permission from Owner’s Representative before using powder-actuated anchors.

B. Obtain permission from Owner’s Representative before drilling or cutting structural members.

3.3 INSTALLATION - GENERAL

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, or spring steel clips.

B. Use toggle bolts or hollow wall fasteners in hollow masonry partitions and walls; expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not support raceways, or boxes from ceiling suspension wires or suspended ceiling systems. Provide support from building structure independently to allow ceiling removal and replacement without removal of electrical system.

D. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling suspension system.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage.

G. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.

H. Earthquake Anchorages:

1. Equipment weighing more than 50 pounds shall be adequately anchored to the building structure to resist lateral earthquake forces.

2. Total lateral (earthquake) forces shall be 1.5 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Conduit.

B. Flexible Metal Conduit.

C. Liquidtight Metal Conduit.

D. Electrical Metallic Tubing.

E. Fittings and Conduit Bodies.

F. Wall and Ceiling Outlet Boxes.

G. Pull and Junction Boxes.

1.2 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions.

B. Division 01 - General Requirements, Summary, Administrative Requirements.

C. Section 26 05 00 – Common Work Results for Electrical.

D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

E. Section 26 05 26 – Grounding and Bonding for Electrical Systems.

F. Section 26 05 29 – Hangers and Supports for Electrical Systems.

G. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

B. American Society for Testing and Materials (ASTM):

1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.

C. National Electrical Manufacturers Association (NEMA):

1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

2. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. National Fire Protection Association (NFPA):

1. NFPA 70 - National Electrical Code.

E. International Building Code (IBC):

1. IBC chapters 16 and 17 seismic requirements.

1.4 RACEWAY AND BOX INSTALLATION SCHEDULE

A. Raceway Minimum Size:

1. Above Grade or Slab on Grade: Provide 1/2 inch minimum, unless otherwise noted.

B. In or through CMU walls:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may penetrate through CMU walls where the EMT is installed in a sleeve and does not come in direct contact with the CMU.

2. Boxes and Enclosures: Provide sheet metal steel metal boxes.

C. Concealed Dry Locations:

1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.

2. Boxes and Enclosures: Provide sheet-metal boxes.

3. Fittings: Provide galvanized malleable iron and steel.

D. Exposed Dry Locations Not Accessible to Inmates:

1. Raceway: Provide intermediate metal conduit. EMT conduit may be used where exposed conduit is allowed where it is not subject to physical damage or where installed on the ceiling or a minimum of ten feet above the floor.

2. Boxes and Enclosures: Provide sheet-metal boxes with raised steel covers.

3. Fittings: Provide galvanized malleable iron and steel.

E. Exposed Dry Locations in Inmate-Accessible Areas:

1. Raceway: Provide rigid steel conduit.

2. Boxes and Enclosures: Provide cast boxes with no pre-punched knockouts.

3. Fittings: Provide galvanized malleable iron and steel. Conduit straps shall be 2-hole type and installed at half the distance shown in NEC table 344.30(B)(2) to allow conduit to be secured to wall without any gaps between conduit and wall.

4. Fasteners: Provide center-pin torx plus screws for all exposed fasteners.

F. Equipment Connections: Provide short extensions (three feet maximum) of flexible metal conduit for connections to motors, vibrating equipment or equipment that requires removal for maintenance or replacement. Use Liquidtight flexible conduit and fittings for motors and equipment in damp or wet locations or subject to spilling of liquids as at pumps, in mechanical rooms, boiler rooms, pump rooms, etc.

1.5 DESIGN REQUIREMENTS

A. Raceway Minimum Size:

1. Line Voltage Circuits: Raceway is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Where a raceway size is not shown on the drawings, it shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9.

B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.

C. Seismic Support: Provide support in accordance with section 26 05 29.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

A. Rigid Steel Conduit: ANSI C80.1, UL 6.

B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted.

C. Provide insulated throat bushings at all conduit terminations.

2.2 INTERMEDIATE METAL CONDUIT (IMC)

A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.

B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.

C. Provide insulated throat bushings at all conduit terminations.

2.3 FLEXIBLE METAL CONDUIT (FMC)

A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full or reduced-wall thickness.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast, or indentor fittings are not acceptable.

2.6 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.

1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.

2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.

B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. "Bell" boxes are not acceptable.

2.7 PULL AND JUNCTION BOXES

A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.

1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.

2.8 EXPANSION FITTINGS

A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.9 BUSHINGS

A. Non-grounding: Threaded impact resistant plastic.

B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.10 LOCKNUTS

A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Provide seismic support and fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.2 INSTALLATION - GENERAL RACEWAY

A. Install raceway for all systems, unless otherwise noted.

B. Install an equipment grounding conductor inside of all raceways containing line voltage conductors.

C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motor and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.

D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.

E. Do not route raceways on floor. Arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square to a tolerance of 1/8" per 10 feet. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.

F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.

G. Do not install raceway imbedded in spray applied fire proofing. Seal raceway penetrations of fire-rated walls, ceilings, floors in accordance with the requirements of Section 26 05 00 and Division 07.

H. Where raceway penetrates fire-rated walls and floors, seal opening around conduit with UL listed firestop sealant or intumescent firestop, preserving the fire time rating of the construction. Install in accordance with Section 07 84 00 Firestopping.

I. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.

J. Arrange raceway supports to prevent misalignment during wiring installation. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

K. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.

L. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.

M. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely. Where locknuts are used, install with one inside box and one outside with dished part against box.

N. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.

O. Install no more than the equivalent of three 90-degree bends between boxes.

P. Install conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.

Q. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.

R. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.

S. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints.

T. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.

U. Use suitable caps to protect installed raceway against entrance of dirt and moisture.

V. Paint all exposed conduit to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.3 INSTALLATION – GENERAL BOXES

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.

B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaries.

C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance.

D. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where normal and emergency power circuits occur in the same box.

F. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.

G. Locate and install boxes to maintain headroom and to present a neat appearance.

H. Provide knockout closures for unused openings.

I. Install boxes in walls without damaging wall insulation or reducing its effectiveness.

J. Install with minimum 24 inches separation in fire rated walls. Limit penetrations in fire rated walls to 16 square inches each and a maximum total combined penetration area of 100 square inches in any given 100 square feet of wall. Where penetrations are in excess of these requirements provided UL listed fire stop wrap acceptable to Authority having Jurisdiction.

K. Do not fasten boxes to ceiling support wires or other piping systems.

L. Support boxes independently of conduit.

M. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish.

N. Provide blank covers or plates for all boxes that do not contain devices.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Nameplates and Tape Labels.

B. Wire and Cable Markers.

1.2 RELATED WORK

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

D. Section 26 24 16 – Panelboards.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved white letters on black background.

B. Letter Size:

1. 1/4-inch high letters for identifying individual panel or equipment.

2. 1/8-inch high letters for remaining lines with 1/8 inch spacing between lines.

C. Minimum nameplate size: 1/8 inch thick with a consistent length and height for each type of nameplate wherever installed on the project.

2.2 TAPE LABELS

A. Product Description: Adhesive tape labels, with 3/16 inch Bold Black letters on clear background made using Dymo RhinoPro 5000 label printer or approved equal.

B. Embossed adhesive tape will not be permitted for any application.

2.3 WIRE MARKERS

A. Power and Lighting Description: Machine printed heat-shrink tubing, cloth or wrap-on type, for all neutrals and Phase conductors.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Degrease and clean surfaces to receive nameplates and tape labels.

B. Install nameplates and tape labels parallel to equipment lines.

3.2 NAMEPLATE INSTALLATION

A. Secure nameplates to equipment fronts using machine screws tapped and threaded into disconnect, or using rivets. The use of adhesives is not acceptable. Machine screws to not protrude more than 1/16 inch on back side.

B. Disconnects, Starters, or Contactors:

1. Provide nameplate for each device with the following information:

a. Line 1: Load served.

b. Line 2: Panelboard and circuit number from which the device is fed.

3.3 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identification shall be as follows:

1. Markers shall be located within one inch of each cable end, except at panelboards, where markers for branch circuit conductors shall be visible without removing panel deadfront.

2. Each wire and cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.

3. Color code phases, neutral, and ground per NEC requirements and Section 26 05 19.

4. For power and lighting circuits, identify with branch circuit number.

5. Control Circuits: Control wire number as indicated on schematic and shop drawings.

3.4 JUNCTION BOX IDENTIFICATION

A. Label each power junction box with the panelboard name and circuit number.

B. For junction boxes above ceilings, mark the box cover with the circuit or system designation using permanent black marker. For junction boxes in finished areas, mark the inside of the cover with the circuit or system designation using permanent black marker.

3.5 PANELBOARD IDENTIFICATION

A. Provide panelboard circuit directories in accordance with Section 26 24 16.

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting and Appliance Branch Circuit Panelboards.

1.2 RELATED SECTIONS

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.

B. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers.

B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

C. UL 50 – Enclosures for Electrical Equipment.

D. UL 67 – Panelboards.

E. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.

F. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Upon arrival at the site inspect equipment and report on any damage.

C. Store in a clean, dry environment.

1.5 WARRANTY

A. Manufacturer shall warrant specified equipment to be free of defects for a period of one year from the date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

A. Cutler Hammer.

B. Substitutions: None.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Branch Circuit Breakers: NEMA AB 1; Provide bolt-on type thermal magnetic trip circuit breakers.

1. 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 with common trip handle for all poles.

2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90^{o}C rated wire, sized according to the 75 ^{o}C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.

2.3 PANELBOARD IDENTIFICATION

A. For each existing panelboard where circuits are added or modified, provide typed schedule denoting each circuit load by the load type and final name and room number actually in use in the facility. Schedule shall not be typed with names shown on the Contract Drawings unless names are acceptable to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide filler plates for unused spaces in panelboards.

B. Panel Schedules: Revise schedules to reflect circuiting changes for new loads.

3.2 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Manual Motor Starters.

1.2 RELATED WORK

A. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).

B. Section 26 05 29 – Hangers and Supports for Electrical Systems.

C. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

D. NEMA KS 1 - Enclosed Switches.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 01.

B. Include recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS

A. Square D.

B. Eaton.

C. Allen Bradley.

D. Siemens.

E. Substitutions: Under provisions of Division 01.

2.2 MANUAL MOTOR STARTERS

A. Manual Motor Starter: NEMA ICS 2; size and number of poles as required by the load served, AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, low voltage protection, red LED pilot light, NO and NC auxiliary contact, and toggle operator.

B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, number of poles as required by the load served, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.

C. Enclosure: ANSI/NEMA ICS 6; Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions.

B. Select and install heater elements in motor starters to match installed motor characteristics.

C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

D. After final connections are made, check and correct the rotation of all motors.

E. Field adjust the trip settings of all motor starter magnetic trip only circuit breakers to approximately 11 times motor full load current. Determine full load current from motor nameplate following installation.

F. Motor starting equipment shall be listed for use with the motors specified under Division 23.

END OF SECTION