1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that has not less than 5 years experience in installing modified bituminous membrane roofing and is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

C. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

D. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: ASTM E 119 (UL 263), Class A for fire-resistance-rated roof assemblies of which roofing system is a part.

E. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers, dry and undamaged, with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, 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. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to prevent moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover rolled goods with a canvas tarpaulin or other breathable material (not polyethylene).

E. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

F. Store all roofing adhesive in a heated area keeping the product above 50 degrees F. minimum.

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

1.8 MANUFACTURER'S INSPECTIONS

A. When the Project is in progress, the roofing system manufacturer shall provide the following:

1. Report progress and quality photographic reports on a weekly basis.

2. Provide job site inspections three days per every five working days.

3. Report to Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.

4. Confirm after completion that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.9 PROJECT 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.

B. Do not apply roofing insulation or membrane to damp deck surface.

C. Do not expose materials subject to water or solar damage in quantities greater than can be weatherproofed during same day.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, walkway products and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and walkway products, for the following warranty period:

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a SBS-modified bituminous membrane roofing system as manufactured by The Garland Company or an equivalent product by one of the following:

1. SR Systems, Division of Simon Roofing.
2. Tremco Incorporated.

2.2 SBS-MODIFIED BITUMINOUS MEMBRANE ROOFING

A. Base Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. Provide StressBase 80 by The Garland Company or approved equivalent.

a. Tensile Strength (ASTM D 5147): 2 in/min. @ 73.4 $\pm$ 3.6 deg. F. MD 100 lbf/in CMD 100 lbf/in.

b. Tear Strength (ASTM D 5147): 2 in/min. @ 73.4 $\pm$ 3.6 deg. F. MD 110 lbf CMD 110 lbf.

c. Elongation at Maximum Tensile (ASTM D 5147): 2 in/min. @ 73.4 $\pm$ 3.6 deg. F. MD 2.5% CMD 2.5%.

d. 80 mil thickness.

e. Bonded to the prepared substrate with solvent free, cold applied adhesive.

B. Roofing Membrane Sheet: ASTM D 6162, Grade S, Type III, rubber modified roofing membrane incorporating recycled rubber and reinforced with a fiberglass/polyester composite scrim; smooth surfaced; suitable for application method specified.

1. Provide StressPly Plus by The Garland Company or approved equivalent.

a. Tensile Strength (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 310 lbf/in CMD 310 lbf/in.

b. Tear Strength (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 500 lbf CMD 500 lbf.

c. Elongation at Maximum Tensile (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 3.5% CMD 3.5%.

d. 105 mil thickness.

C. Base Flashing Sheet: ASTM D 6162, Grade S, Type III, glass-fiber/polyester reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. Provide FlexBase E 80 by The Garland Company or approved equivalent.

a. Tensile Strength (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 500 lbf/in CMD 550 lbf/in.

b. Tear Strength (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 900 lbf CMD 950 lbf.

c. Elongation at Maximum Tensile (ASTM D 5147): 2 in/min. @ 73.4 ± 3.6 deg. F. MD 4% CMD 4%.

d. 80 mil thickness.

e. One ply of SBS base flashing ply covered by an additional layer of modified bitumen membrane and set in solvent free, cold applied adhesive.

D. White Elastomeric Roof Coating: Energy Star approved, white, non-toxic, acrylic roof coating; suitable for application method specified, and as follows:

1. Provide Pyramic by The Garland Company or approved equivalent.

a. Weight/Gallon: 12 lbs./gal.; Elongation (ASTM D 2370): 100% min.; Tensile Strength (ASTM D 2370): 200 psi minimum.

b. Non-Volatile % (ASTM D 1644): 66% min.

c. Color: White.

d. Coverage: 1-1.5 gal./100 sf per coat, two coat application required.

e. Reflectance: 0.83; Emittance: 0.88; SRI: 104.

2.3 AUXILIARY ROOFING MEMBRANE MATERIALS

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

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

B. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

C. Bead-Applied Insulation Adhesive: One component, low-rise, solvent free, asbestos-free, modified urethane foam adhesive formulated to attach roof insulation to substrate or to another insulation layer and as recommended by insulation manufacturer and approved by FM indicated ratings.

1. Basis of Design: Insul-Loc II by The Garland Company Inc. or approved equivalent.

2. Tensile Strength (ASTM D 412): 250 psi; Density (ASTM D 1875): 8.5 lbs/gal.; Viscosity (ASTM D 2556): 16,000 to 24,000 cP; Peel Strength (ASTM D 903): 17 lb/in.; Flexibility (ASTM D 816): Pass @ -70 deg. F.

D. Membrane Adhesive: Cold-applied solvent free membrane adhesive, zero VOC, polyether.

1. Basis of Design: Green-Loc by The Garland Company Inc. or approved equivalent.

2. Membrane adhesive to have the following characteristics:
   a. Non-Volatile Content ASTM D4586 100%
   b. Density ASTM D1475 11.2 lbs./gal. (1.11 g/m3)
   c. Viscosity Stormer ASTM D562 16-20 sec.
   d. Flash Point ASTM D93 400 F min. (232 C)
   e. Slope: up to 3:12

E. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.4 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers:

   a. Apache Products Company.
   b. Atlas Roofing Corporation.

c. Celotex Corporation.
d. Firestone Building Products Company.
e. GAF Materials Corporation.
f. Johns Manville International, Inc.
g. Koppers Industries.
h. RMAX.

2. Base Thickness: 2 inches; Minimum R-value for 2 inches = R12.

3. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches; Cricket slope: 1/2 inch per 12 inches as indicated on Drawings; Average system R-value = 30.

C. Overlay Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2-inch thick, to be installed over tapered roofing insulation and as recommended by modified bituminous membrane roofing manufacturer.

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

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Insulation Cant Strips: ASTM C 728, perlite insulation board.

2.6 WALKWAYS

A. Walkway Cap Sheet Strips: ASTM D 6163, Grade G, Type I or II, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified, and as acceptable to roofing system manufacturer, and as follows:

1. Granule Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that concrete substrate is visibly dry and free of moisture.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system 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.

3.3 INSULATION INSTALLATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.

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

D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

E. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 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.

F. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

G. Adhered Insulation:

1. Adhere first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof in accordance with specified uplift requirements.
2. Apply insulation adhesive directly to the substrate using a ribbon pattern with one half (1/2) inch wide beads, using either the pail or an automatic applicator, at a rate of one (1) gallon per one hundred (150) square feet.
3. Immediately place insulation boards into wet adhesive. Do not slide boards into place. Do not allow the adhesive to skin over before installing insulation boards.
4. Briefly step each board into place to ensure contact with the adhesive.
5. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
6. Adhere overlay boards over insulation with long joints in continuous straight lines with end joints staggered between rows.
7. Adhere overlay boards to resist uplift pressure at corners, perimeter, and field of roof.

3.4 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:

1. Deck Type: C (Concrete).

2. Adhering Method: L (cold-applied adhesive).

3. Base Sheet: One.

4. Number of Glass-Fiber Base Flashing-Ply Sheets: One.

5. Number of SBS-Modified Membrane Sheets: One.

6. Surfacing Type: Energy Star white acrylic based coating ASTM G26.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Substrate-Joint Penetrations: Prevent roofing adhesive from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.5 BASE-SHEET INSTALLATION

A. Install lapped base sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
1. Adhere to substrate in a uniform coating of adhesive .

3.6 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing membrane sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Adhere to substrate in cold-applied adhesive.

2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

C. Install roofing membrane sheets so side and end laps shed water.

3.7 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
1. Backer Sheet Application: Install backer sheet and adhere to substrate in cold-applied adhesive at rate required y roofing system manufacturer.
2. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at arate required by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

D. Roof Drains: Set 30-by-30-inch (760-by-760-mm) metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.

1. Install stripping according to roofing system manufacturer's written instructions.

3.8 REFLECTIVE WHITE ACRYLIC COATING INSTALLATION

A. Prior to installation of surface, obtain approval from manufacturer as to work completed.

B. Reflective white acrylic coating:

1. Allow all cold applied solvent free flashing adhesive to properly dry and cure before installing the reflective coating.

2. Coat all exposed roofing with manufacturer's reflective coating installed at a rate of one (1) gallon per square per coat in a two coat application.

3.9 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.

1. Set walkway pads in cold-applied adhesive.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will 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. Protect roofing system from damage due to dirt and foreign materials, and prevent accumulation of construction debris from other trades. Keep roofing system clean by removing all construction materials from the roof. Prevent roofing system from being stained by removing all dirt and debris from roof as soon as possible. Repair or reinstall all stained roofing system materials to a condition free of damage and stains.

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

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

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner.>
2. Address: <Insert address.>
3. Building Name/Type: <Insert information.>
4. Address: <Insert address.>
5. Area of Work: <Insert information.>
6. Acceptance Date: <Insert date.>
7. Warranty Period: <Insert time.>
8. Expiration Date: <Insert date.>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. lightning;
   b. peak gust wind speed exceeding 90 mph;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not

become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature.>
2. Name: <Insert name.>
3. Title: <Insert title.>

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manufactured Products:

a. Manufactured reglets and counterflashing.

2. Formed Products:

a. Formed roof drainage sheet metal fabrications.
b. Formed low-slope roof sheet metal fabrications.

B. Related Sections:

1. Division 23 Sections for set-on-type curbs, equipment supports, vents, and other manufactured roof accessory units.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated 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.

B. Fabricate and install roof edge flashing and copings capable of resisting the wind loads and design pressures as indicated on the Drawings.

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

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.

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

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.

D. Qualification Data: For qualified fabricator.

E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Preinstallation Conference: Conduct conference at Project site

1. Meet with Owner, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.

4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

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

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

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

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

B. 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.

1. Surface: Smooth, flat.

2. Exposed Coil-Coated Finishes:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: "White". Submit color samples for approval by Architect.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.2 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.3 MISCELLANEOUS MATERIALS

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

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

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

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

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

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

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cheney Flashing Company.
b. Fry Reglet Corporation.
c. Heckmann Building Products Inc.
d. Hickman, W. P. Company.
e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
f. Keystone Flashing Company, Inc.
g. National Sheet Metal Systems, Inc.
h. Sandell Manufacturing Company, Inc.

2. Material: Aluminum, minimum 0.024 inch (0.61 mm) thick.

3. Surface-Mounted Type: Provide with termination bar for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

4. Accessories:

a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

5. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

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

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Fabricate downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Fabricated Hanger Style: SMACNA figure designation 1-35D
2. Fabricate from the following materials:
   a. Aluminum: 0.024 inch (0.61 mm) thick.
   b. Size: As indicated on Drawings.

B. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

C. Splash Pans: (Where indicated on Drawings) Fabricate from the following materials:

1. Aluminum: 0.040 inch (1.02 mm) thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Coping Profile: As indicated on drawings.
2. Joint Style: Butt, with 12-inch- (300-mm-) wide, concealed backup plate and 6-inch- (150-mm-) wide, exposed cover plates.
3. Fabricate from the following materials:
   a. Aluminum: 0.050 inch (1.27 mm) thick.

B. Base Flashing: Fabricate from the following materials:

1. Aluminum: 0.040 inch (1.02 mm) thick.

C. Counterflashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm) thick.

2. Lead: 4.olb/sq.ft. hard tempered.

3. Lead coated copper: 17.2 oz/sq.ft.

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Copper: 12 oz./sq. ft. (0.41 mm) thick.
2. Stainless Steel: 0.016 inch (0.40 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings,

separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws, metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.
2. Pre-tinning is not required for zinc-tin alloy-coated copper.
3. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

G. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

C. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement compatible with roofing membrane.

D. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
2. Anchor interior leg of coping with screw fasteners and washers through slotted holes at 24-inch (600-mm), 20-inch (500-mm) centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant or anchor and washer at 36-inch (900-mm) centers.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Reglets: Install reglets as indicated on Drawings.

3.7 ERECTION TOLERANCES

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

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

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

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

B. Related Sections:

1. Section 092900 "Gypsum Board" for sealing perimeter joints.
2. Section 095113 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 PRECONSTRUCTION TESTING

A. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 ACTION SUBMITTALS

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

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

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

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

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

D. Preinstallation Conference: Conduct conference at Project site.

1.7 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 permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
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.

1.8 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which 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's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 2 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 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

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

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Pecora Corporation; 890FTS.
d. Sika Corporation, Construction Products Division; SikaSil-C990.
e. Tremco Incorporated; Spectrem 1.
f. Approved equivalent.

B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; 898.
b. Tremco; Tremsil 600 White.
c. Approved equivalent.

2.3 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Building Systems; Sonolac.
b. Bostik, Inc.; Chem-Calk 600.
c. Pecora Corporation; AC-20+.
d. Tremco Incorporated; Tremflex 834.
e. Approved equivalent.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; AC-20 FTR.
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. Approved equivalent.

2.5 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), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with

joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.
b. Masonry.
c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.
c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

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

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

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

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

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

E. 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

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. Joints at metal flashings and termination bars.
b. Joints at cast-in-place concrete.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
e. Other joints as indicated.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Perimeter joints of exterior openings where indicated.
   b. Vertical joints on exposed surfaces of interior unit masonry, concrete walls and partitions.
   c. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
   d. Joints at perimeter edges of drywall.
   e. Other joints as indicated.

2. Joint Sealant: Latex, Acrylic based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated..
   c. Other joints as indicated.

2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:

   a. Acoustical joints where indicated.
   b. Other joints as indicated.

2. Joint Sealant: Acoustical.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
1. Division 09 Section "Acoustical Panel Ceilings" for suspended acoustical panel ceilings.
2. Division 23 Section "Heating Ventilating and Air Conditioning" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are

listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for vertical access doors and frames.
2. ASTM E 119 or UL 263 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

1. ASTM A 123/A 123M, for galvanizing steel and iron products
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Steel Sheet: Electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

E. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to

the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

F. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. Bar-Co, Inc. Div.; Alfab, Inc.
4. Dur-Red Products.
5. Elmdor/Stoneman; Div. of Acorn Engineering Co.
6. Jensen Industries.
7. J. L. Industries, Inc.
8. Larsen's Manufacturing Company.
9. MIFAB, Inc.
10. Milcor Inc.
11. Nystrom, Inc.
12. Williams Bros. Corporation of America (The).

B. Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.
4. Hinges: Continuous piano.
5. Lock: Key operated cylinder lock.
6. Size: As indicated on Drawings.

C. Fire-Rated, Insulated, Medium-Security, Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.

1. Locations: Wall surfaces.
2. Fire-Resistance Rating: 1-hour and 2-hour fire-rated. See floor plans for locations and fire-ratings of walls.
3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
4. Door: Flush panel with a core of 2-inch- (50-mm-) thick, mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.075 inch (1.9 mm).
5. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch- (25-mm-) wide, surface-mounted trim.

6. Hinges: Continuous piano.
7. Automatic Closer: Spring type.
8. Lock: Key-operated cylinder lock with interior release.
9. Size: As indicated on Drawings.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
2. For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes gypsum board shaft-wall assemblies for the following:

1. Shaft-wall enclosures.
2. Chase enclosures.
3. Horizontal enclosures.

1.3 SUBMITTALS

A. Product Data: For each gypsum board shaft-wall assembly indicated.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures for installing gypsum board shaft-wall assemblies including, but not limited to, the following:

1. Fasteners proposed for anchoring nonstructural steel framing to building structure.
2. Wiring devices in shaft-wall assemblies.
3. Doors and other items penetrating shaft-wall assemblies.
4. Items supported by shaft-wall-assembly framing.
5. Mechanical work enclosed within shaft-wall assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum Company.
2. BPB America Inc.
3. G-P Gypsum.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. USG Corporation.

2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.

1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

2.3 PANEL PRODUCTS

A. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.

1. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.

a. Core: 1 inch (25.4 mm) thick.

b. Long Edges: Double bevel.

2. Moisture- and Mold-Resistant Type X: Manufacturer's proprietary liner panels with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.

a. Core: 1 inch (25.4 mm) thick.
b. Long Edges: Double bevel.

B. Gypsum Board: As specified in Division 09 Section "Gypsum Board."

C. Water-Resistant Gypsum Backing Board: As specified in Division 09 Section "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

A. Framing Members: Comply with ASTM C 754 for conditions indicated.

B. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
1. Protective Coating: ASTM A 653/A 653M, G40 (Z120) hot-dip galvanized, unless otherwise indicated.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.

C. Gypsum Base Joint-Reinforcing Materials: As specified in Division 09 Section "Gypsum Board."

D. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

E. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

F. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

G. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.

B. Fire-Resistance Rating: 2 hours.

C. STC Rating: 51, minimum.

D. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.

1. Depth: As indicated on Drawings.
2. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).

E. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm) long and in depth matching studs.

1. Minimum Base-Metal Thickness: Matching steel studs.

F. Room-Side Finish: As indicated.

G. Shaft-Side Finish: As indicated.

H. Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

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

3.2 INSTALLATION

A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
2. Division 09 Section "Gypsum Board" for applying and finishing panels.
3. Division 09 Section "Tiling" for cementitious backer units.

B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

F. Control Joints: Install control joints at locations indicated on Drawings, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.

G. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.

H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Related Sections include the following:

1. Division 07 Section "Thermal Insulation" for insulation installed with Z-shaped furring members.
2. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm).

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
b. Depth: 1-5/8 inches (41.3 mm).

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.

G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640-C Fire Front 650-C Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm) except use 0.0312 inch as follows:

a. For head runner, sill runner, jamb, and crippled studs at door and other openings.
b. In locations to receive ceramic tile backing panels.

2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).

D. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: As indicated on Drawings.

F. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

G. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 3/4 inch (19.1 mm) unless noted otherwise.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth of 1-1/2 inches.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
b. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

E. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm)o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092500 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

B. Related Sections include the following:

1. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BPB America Inc.
b. G-P Gypsum.
c. National Gypsum Company.
d. USG Corporation.

B. Type X:

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead; use outside corners, unless otherwise indicated.
b. Bullnose bead; paper-faced metal 1 ½, tape on bead, use at outside corners at all public corridor conditions and where indicated.
c. LC-Bead: J-shaped; exposed long flange receives joint compound; use for edge trim, unless noted otherwise.
d. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Form control and expansion joints with space between edges of adjoining gypsum panels.

E. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: As indicated on Drawings.

B. Single-Layer Application:

1. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. Bullnose Bead: Use at outside corners where indicated.
3. LC-Bead: Use for edge trim.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092500

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:

1. Acoustical panels and exposed suspension systems for ceilings. (APC)

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.

D. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panels: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings—Seismic Zones 0-2."
2. IBC Section 1621 "Architectural, Mechanical and Electrical Component Seismic Design Requirements."; Meet requirements for Seismic Design Category C.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 WATER-FELTED, MINERAL BASED ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-1)

A. Basis-of-Design Product:

1. Armstrong, GEORGIAN #1750, Angled Tegular.

B. Acceptable Manufacturers:

1. USG.

2. Approved equivalent.

C. Color: White.

D. LR: Not less than 0.86.

E. NRC: Not less than 0.65.

F. CAC: Not less than 35.

G. Edge/Joint Detail: Angled Tegular.

H. Thickness: 3/4- inch.

I. Modular Size: 24 by 24 inches.

J. Antimicrobial Treatment: Odor and bactericide based treatment.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance, where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Seismic Stabalizer Bars: Manufacturer's standard perimeter stabilizer bars designed to accommodate seismic forces.

F. Hold-Down/Bracing Attachment Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING (APC-1)

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc., PRELUDE or approved equivalent from the following manufacturers. Color to match adjacent panel product.
2. BPB USA
3. Chicago Metallic Corporation
4. Ecophon CertainTeed, Inc
5. USG Interiors, Inc.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. Face Design: Flat, flush.
3. Cap Material: Steel cold-rolled sheet.
4. Cap Finish: Painted white.
5. High humidity finish at APC-1 ceilings.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Available Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. Chicago Metallic Corporation
3. Fry Reglet Corporation
4. USG Interiors, Inc.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated. See ceiling details.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. Or equal presented and approved prior to bidding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with IBC Section 1621 "Architectural, Mechanical, and Electrical Component Seismic Design Requirements" for Seismic Design Category C and with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers post-installed mechanical, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. Install panels with pattern running in one direction, and as indicated in Reflected Ceiling Plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:
1. Section 096519 "Resilient Tile Flooring".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C)or more than 95 deg F (35 deg C) in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (RB-1)

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong World Industries, Inc.
   b. Johnsonite.
   c. Mannington Industries.
   d. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP.
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove base with toe recess profile.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Finish: Matte or Low luster.

2.2 Colors and Patterns: As indicated on Drawings and as selected by Architect from full range of industry colors. RESILIENT BASE (RB-2)

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong World Industries, Inc.
   b. Johnsonite.
   c. Mannington Industries.
   d. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP.
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove base with toe recess profile.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 6 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Finish: Matte or Low luster.

I. Colors and Patterns: As indicated on Drawings and as selected by Architect from full range of industry colors.

2.3 RESILIENT MOLDING ACCESSORIES

A. Resilient Molding Accessories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

   a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   b. Flexco, Inc.
   c. Johnsonite.
   d. Roppe Corporation, USA.

e. VPI, LLC; Floor Products Division.

B. Description: Transition strips.

C. Material: Rubber.

D. Profile and Dimensions: As required for transition from resilient flooring to carpet or existing surfaces.

E. Colors and Patterns: Manufacturer's Standard, as selected by Architect from full-range.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Transition Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet that requires ramped transition to higher or lower adjacent material. Miter corners where two perpendicular ramps meet. Adequately secure ramped transition to floor and carpet to withstand high-traffic conditions.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519- RESILIENT TILE FLOORING

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. Luxury Vinyl Tile. (LVT)
2. Vinyl Composition Tile. (VCT)

B. Related Sections:
1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Qualification Data: For qualified Installer.

E. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) , in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C). Close spaces to traffic during floor tile installation.

C. Close spaces to traffic for 48 hours after floor tile installation.

D. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE (LVT-1)

A. Basis of Design: **See Finish Schedule for Basis of Design selection.** Subject to compliance with requirements, provide one of the following:
1. Amtico International, Stone Series.
2. Armstrong World Industries, Natural Creations.
3. Johnsonite, I.D. Premier Tile.
4. Mannington, Nature's Path Select.

B. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.

C. Wearing Surface:

1. Pattern Figure/Color: To be selected by Architect from Manufacturer's Full Range.

D. Thickness: 0.125 inch.

E. Size: 12 x 18 inches or 18 x 18 inches.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 VINYL COMPOSITION TILE (VCT)

A. Basis of Design: See Finish Schedule. Subject to compliance with requirements, provide equivalent from one of the following:

1. Mannington.
2. Armstrong.
3. Johnsonite.

B. Wearing Surface: Smooth.

C. Thickness: 0.125 inch.

D. Size: 12 by 12 inches.

E. Colors and Patterns: As selected by Architect from full range of industry colors to match Architect's Selection.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Floor Polish (for VCT): Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:
1. Modular, fusion-bonded carpet tile.

B. Related Sections include the following:
1. Division 02 Section "Selective Demolition" for removing existing floor coverings.
2. Division 09 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways,enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern type, location, and direction.
6. Type, color, and location of insets and borders.
7. Type, color, and location of edge, transition, and other accessory strips.
8. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample for each type.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to carpet tile installation including, but not limited to, the following:

1. Review delivery, storage, and handling procedures.
2. Review ambient conditions and ventilation procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
3. Warranty Period: 15 years from date of Substantial Completion for Wear. Lifetime Antimicrobial and Stain Resistance Warranty.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to **5** percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT)

A. Basis of Design Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following **'Textured Patterns'** to match Architect's Sample:

1. See Finish Schedule for product/style designation for Basis of Design products.

a. Color: To be selected from Mfr.'s Full Range.
b. Pattern: Match Architect's samples for scale of pattern—multi-level organic.

B. Fiber Content: Post-Consumer Content Type 6,6 Nylon, Solution Dyed and Yarn Dyed.

C. Pile Characteristic: Tufted Cut and Loop.

D. Tufted Yarn Weight: 20 oz/yd2., minimum.

E. Backing System: EcoFlex ICT or equivalent.

F. Size: 24 x 24 or similar module.

G. Warranty: Lifetime Limited Modular Warranty, Lifetime Stain Warranty.

H. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.

2. Indoor Air Quality: Green Label Plus Certified

3. Radiant Panel: ASTM E-648 Class 1

4. Smoke Density: ASTM E-662

5. Static: AATCC-134 <3.0KV

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:

a. Total VOCs: 10.00 mg/sq. m x h.
b. Formaldehyde: 0.05 mg/sq. m x h.
c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on, but not limited to the following interior substrates:

1. Steel.
2. Galvanized metal.
3. Wood.
4. Gypsum board.
5. Concrete.
6. Plaster.

1.3 ACTION SUBMITTALS

A. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Label each Sample for location and application area per designation on Finish Schedule.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of **each** paint system/color indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

b. Trim: Provide samples of at least 5 lineal ft.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers:
1. Benjamin Moore & Co.
2. Duron, Inc.
3. ICI Paints.
4. PPG Architectural Finishes, Inc.
5. Rose Talbert.
6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pretreatment Wash Primers: 420 g/L.

C. Colors: To match Architect's selection, and per mock-up adjustments, as required. See Finish Schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.
2. Gypsum Board: 12 percent.
3. Concrete: 12 percent.
4. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth. Make minor repairs if necessary.

D. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
5. Paint with same system, as original coats.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 2–Eg-Shel), MPI #138.

B. Galvanized-Metal Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, galvanized, water based, MPI #134.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss: Level 2–Eg-Shel), MPI #138.

C. Wood Substrates: Existing wood doors.

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss: Semi-Gloss, or Gloss, to Match Existing or Adjacent Trim. System shall be compatible with previous coats, oil or latex.

D. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork, wood-based panel produccts:

1. Semi-Transparent Stain System: INT 6.4C

a. Prime Coat: Stain, semi-transparent, for interior wood, MPI #90.
b. Topcoat: Stain, semi-transparent, for interior wood, MPI #90.

E. Gypsum Board Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss: Level 2–Eg-Shel), MPI #138.

F. Concrete Substrates: Walls.

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural, (Gloss: Level 2–Eg-Shel), MPI #138.

G. Underside of existing concrete slabs:

1. Latex System: MPI INT 9.1A:

a. Prime Coat: Primer, Alkali Resistant, Water Based, MPI #3;
Basis of Design: Loxon Concrete & Masonry Primer. A24W300 Series by Sherwin Williams Company.

b. Topcoat: Latex Stucco and Masonry Textured Coating: MPI #42;
Basis of Design: UltraCrete Textured Masonry Topcoat. A44W800 Series by Sherwin Williams Company.

H. Plaster Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss: Level 2–Eg-Shel), MPI #138.

END OF SECTION 099123

SECTION 210010 - GENERAL PROVISIONS – FIRE PROTECTION

PART 1 - GENERAL

SCOPE:

Bids of work covered by each section of these specifications shall be based on the "Fire Protection Sprinkler System Specification Sheet". Contractor shall carefully investigate structural and finish conditions affecting his work and shall arrange such work accordingly as may be required to meet such conditions. Where locations make it necessary or desirable from Contractor's standpoint to make changes in arrangements or details shown on drawings, he may present suggestions for such changes and obtain Engineer's approval prior to making such changes.

CODES:

All work under this division shall be in strict compliance with "International Codes" – 2009 Edition, NFPA – 2010 Edition, and all applicable Codes and Regulations of the City of Columbia, South Carolina.

MATERIAL AND SHOP DRAWINGS:

Use only new materials and the standard product of a single manufacturer for each article of its type unless specifically mentioned otherwise. Materials and workmanship in the case of assembled items shall conform to the latest applicable requirements of NFPA, NEC, ASTM, and ANSI.

Schedule submittals to expedite work. Unless otherwise indicated in this Section, submittals shall be submitted within 30 days of date of Notice to Proceed. Provide six (6) copies of submittals for review and approval. Provide folders or binders for each submittal. All submittals shall be bound in a single volume. Partial lists will not be considered and will be returned to the Contractor. Identify Project, Contractor, subcontractor, supplier, manufacturer, pertinent drawing sheet and detail numbers, and associated specification section numbers. A table of contents shall be included in the front of the submittal with tabs indicating each section. Identify variations from requirements of Contract Documents.

Contractor responsibilities:
Review submittals prior to transmittal. Verify compatibility with field conditions and dimensions, product selections and designations, quantities, and conformance of submittal with requirements of Contract Documents. Return non-conforming submittals to preparer for revision rather than submitting to Engineer. Coordinate submittals to avoid conflicts between various items of work. Failure of Contractor to review submittals prior to transmittal to Engineer shall be cause for rejection. Incomplete, improperly packaged, and submittals from sources other than Contractor will not be accepted. Submittals not stamped APPROVED and signed by the Contractor will be returned to the Contractor.

Where required by specifications or otherwise needed, prepare drawings illustrating portion of work for use in fabricating, interfacing with other work, and installing products. All equipment submitted shall be of adequate size and physical arrangement to allow unobstructed access when installed, for routine maintenance and other similar operations. Contract Drawings shall not be reproduced and submitted as shop drawings. Title each drawing with Project name and reference the sheet the drawing corresponds to.

Provide product data such as manufacturer's brochures, catalog pages, illustrations, diagrams, tables, performance charts, and other material which describe appearance, size, attributes, code and standard compliance, ratings, and

other product characteristics. Provide all critical information such as reference standards, performance characteristics, capacities, power requirements, wiring and piping diagrams, controls, component parts, finishes, dimensions, and required clearances. Submit only data which are pertinent. Mark each copy of manufacturer's standard printed data to identify products, models, options, and other data pertinent to project.

Engineer will review and return submittals with comments. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance. Promptly report any inability to comply with provisions. Revise and resubmit submittals as required within 15 days of return from Engineer. Make re-submittals under procedures specified for initial submittals. Identify all changes made since previous submittal.

Engineer Review:
Detailed drawings, including proposed head layouts, shall be prepared by the Fire Protection Contractor. These drawings shall be submitted to the Engineer for their approval. Upon approval by the engineer, it shall be the responsibility of this contractor to submit the approved shop drawings to the Office of the State Fire Marshal for their approval. All approvals shall be received prior to starting work. Upon receipt of the approval from the Office of the State Fire Marshal, this contractor shall provide one set of approved shop drawings to the Office of the State Engineer and one set to the City of Columbia for their records.

Samples:
Submit samples to illustrate functional and aesthetic characteristics of products with all integral parts and attachment devices. Include full range of manufacturer's standard finishes, indicating colors, textures, and patterns for A/E selection. Submit the number of samples specified in individual specification sections. One sample will be retained by A/E.

Items Requiring Submittal are as Follows:

All items listed in MANUFACTURERS: Section of 210010

ASBESTOS:

Contractor shall refer to the bid documents for asbestos information on removal. At any time the Contractor encounters asbestos at locations other than those noted, he shall immediately stop work in the immediate area and suspend any further work until asbestos is removed. Contractor shall, upon discovery of asbestos, notify owner, or owner's representative, who shall direct the General Contractor for the removal of the asbestos, all in accordance with NESHAP (National Emission Standard for Hazardous Air Pollutants). Any form of asbestos removal or demolition shall be by Asbestos Removal Contractor. Engineer is not an "Owner or Operator" as defined under NESHAP.

Contractor is responsible for, and shall be aware of all state and federal laws pertaining to asbestos as well as NESHAP requirements.

PERMITS AND FEES:

Obtain permits, licenses, pay fees, etc. as required for performance of Contract. Arrange for necessary inspections required by governing authority and deliver certificates of approval to Architects or their representatives. File plans required by governing body.

DEFINITIONS:

In this division of the specifications and accompanying drawings, the following definitions apply:

Provide: To purchase, pay for, transport to the job site, unpack, install, and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware, and operations required for completion and operation.

Install (Installed): To furnish and install complete and ready for operation.

CUTTING AND PATCHING:

Cutting of walls, floors, roofs, partitions, and ceiling, required for proper installation of the systems shall be performed under this contract.

Cutting shall be done in a neat, workmanlike manner. No joist, beams, girders, columns, or other structural members may be cut without written permission from the Engineer. When possible, holes shall be saw-cut or core drilled neat to minimize patching.

Re-routing of existing pipes, insulation, etc. as required for installation of new system is included in this work. All work shall be done in accordance with specifications for new work of the particular type involved.

Patching shall be performed to match existing structures, exterior walls and roofs, and shall form watertight installation.

VERIFICATION OF DIMENSIONS, ETC.:

The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make in quadruplicate for approval before starting the work. Contractor shall install all equipment in a manner to avoid building interference.

COORDINATION WITH OTHER TRADES:

Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. Before beginning work under each section, inspect installed work of other trades and verify that such work is complete to the point where the installation may properly begin.

PROTECTION OF ADJACENT WORK:

Protect work and adjacent work at all times with suitable covering. All damage to work in place caused by Contractor shall be repaired and restored to original good and acceptable condition using same quality and kinds of materials as required matching and finishing with adjacent work.

EXISTING EQUIPMENT AND MATERIALS:

All items of equipment removed under this section of the specifications shall become the property of this Contractor shall be promptly removed from this site.

FIRESTOPPING:

Provide firestopping for all mechanical penetrations through fire resistant walls and shaft enclosures, and floor, ceiling, and roof elements of fire resistant assemblies. Firestopping shall provide rating comparable to rating of structure it protects.

Firestopping materials currently classified with UL as "Through Penetration Firestop Systems".

Firestopping materials shall have been tested in accordance with UL 1479 "Fire Tests of Through Penetration Firestops".

CLEAN-UP:

At the completion of the contract work, all areas where work has been performed shall be left clean. All trash shall be removed from the site by the Contractor.

APPROVALS AND SUBSTITUTIONS:

Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, or type of construction which, in the judgment of the Engineer, expressed in writing, is equal to that specified.

Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified, shall be submitted for approval to the Engineer ten (10) days prior to bid date. Requests shall be accompanied by samples, descriptive literature and engineering information as necessary to fully identify and evaluate the product. No increase in the contract sum will be considered when requests are not approved.

AS-BUILT DRAWINGS:

The Contractor shall keep a record set of drawings on the job; and as construction progresses shall show the actual installed location of all items, material, and equipment on these job drawings. Indicate approved changes in red ink.

At the time of final completion, a corrected set of As-Built drawings shall be delivered to the Engineer. A final set of reproducible drawings with job information that reflects the actual installation shall be prepared by the Engineer and given to the Owner.

WARRANTY:

The Contractor for each section of the work under this division will furnish to the Owner a written warranty for the installation as installed of all equipment covered under each section of the specifications, to perform in a satisfactory manner with no more than normal service.

Each warranty shall extend for a period of one year following substantial completion and acceptance of construction. They shall be endorsed by the Contractor.

MANUFACTURERS:

In order to define requirements for quality and function of manufactured products, and requirements such as size, gauges, grade selection, color selections and like specifications requirements, the specifications as written hereinafter are based upon products of those manufacturers who are named hereinafter under various specifications for materials.

In addition to products of manufacturers named hereinafter in the specifications, equivalent products of the following named manufacturers will be acceptable under the base bid:

Pipe Hangers:

Cooper B-Line, Fee and Mason Manufacturing Company, Anvilstar International, Erico Caddy, Tolco a Division of Nibco

Sprinklers:

Viking Group, Reliable Automatic Sprinkler Company, Tyco Fire Products

Identification Items:

Seton Name Plate Company, W.H. Brady Company, Handley Industries, Inc.

PART 2 - PRODUCTS

PAINTING:

Furnish touch up paint supplied by equipment manufacturer.

VALVES:

All valves provided under each section shall be of a single manufacturer unless otherwise specified. Valve manufacturer and pressure rating shall be cast on side of valve body. Each threaded valve shall have a union installed adjacent to it.

EQUIPMENT ACCESSORIES:

Lubrication: Provide oil level gauges, grease cups, and grease gun fittings for all equipment bearings as recommended by equipment manufacturer. All grease gun fittings shall be of a uniform type.

FIRESTOPPING MATERIALS:

The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inches of water at the location of the test specimen for the time period equivalent to the fire resistance rating of the construction penetrated. Material shall be capable of curing in the presence of atmospheric moisture to produce durable and flexible seal, and will form airtight and watertight bonds with most common building materials in any combination including cement, masonry, steel, and aluminum.

SLEEVES AND OPENINGS:

Provide UL certified fire stop sleeving system for all pipe penetrations through fire rated walls, floors, partitions, ceilings, floor-ceiling assemblies and roofs as tested under ASTM E814 "Standard Method of Fire Tests of Through Penetration Fire Stops" – 2009 Edition.

SEISMIC RESTRAINTS:

Complete installation of new piping on fire protection system shall meet the seismic requirements of NFPA 13 – 2010 Edition and the International Building Code.

PART 3 - EXECUTION

PIPE FITTINGS:

General: Provide complete systems of piping and fittings for all services as indicated. All pipe, valves, and fittings shall comply with American National Standards Institute, Inc. Code and/or local codes and ordinances. Cut pipe accurately to measurements established at building or site, and work into place without springing or forcing, properly clearing all windows, doors, and other openings or obstructions.

Excessive cutting or other weakening of building to facilitate piping installation will not be permitted. Piping shall line up flanges and fittings freely and shall have adequate unions and flanges so that all equipment can be disassembled for repairs. Test all piping prior to insulation or concealing.

PIPE:

All piping material shall be as specified in other sections of this division.

SLEEVES:

Provide all sleeves in floors, beams, wall, roof, etc. as required for installing work of this division unless otherwise specified hereinafter. Sleeves thru fire-rated assemblies shall be firestopped as specified herein and insulation shall not pass thru sleeve unless material complies with firestopping specified.

PIPE HANGERS, SUPPORTS AND INSERTS:

Pipe hangers, supports and inserts shall comply with the requirements of NFPA.

Hanger or Support Spacing (unless specified different hereinafter):

Hanger or support maximum spacing shall be as required by NFPA.

CLEANING:

All surfaces on metal, pipe, covered surfaces, and other equipment furnished and installed under this division of the specifications shall be thoroughly cleaned of grease, scale, dirt and other foreign material.

TESTING (PIPING):

Upon completion of each system of work under this division, and at a designated time, all piping shall be pressure tested for leaks in the presence of the owner. Owner shall be notified five days before testing is to be conducted and all tests shall be conducted in the presence of the owner. All equipment required for test shall be furnished by contractor at his expense. All tests shall be performed as specified hereinafter. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated at no additional cost to owner. Make tight any leaks. Repeat tests until system is proven tight. Caulking of leaks will not be permitted. All equipment not capable of withstanding the test pressure shall be valved off during the test.

All sprinkler piping shall be tested hydrostatically at not less than 200 pounds per square inch pressure for two hours and shall meet all requirements of Underwriters.

OPERATION AND MAINTENANCE INSTRUCTIONS, AND MAINTENANCE MANUAL:

Upon completion of work, and at a time designated by the engineer, a competent employee of the contractor shall be provided to instruct a representative of the owner in the operation and maintenance of the system.

Minimum instruction period shall be:

- Fire Protection System - 1/2 day

Maintenance Manuals: The contractor shall compile and bind five (5) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. These instructions shall be delivered through the general contractor to the engineer for approval prior to final inspection.

Instructions shall include:

- Warranty letter signed by the Fire Protection Contractor.
- Index for each section with each section properly identified.
- Complete equipment list with model and serial numbers.
- Copy of one complete, approved submittal for each equipment section.
- Description of each system, including manufacturer's literature for all items.
- Start-up and shut-down description for each system.
- Suggested operating and maintenance instructions with frequency of maintenance indicated.
- Parts list for all items of equipment.

Manuals shall be 8-1/2 x 11 inch text pages bound in three ring expansion binders with a hard durable cover with clear plastic pocket on front for title page. Prepare binder covers with printed subject title of manual, title of project, date, and volume number when multiple binders are required. Printing shall be on face and spine. Provide a table of contents for each volume. Internally subdivide the binder contents with divider sheets with typed tab titles under reinforced plastic tabs. Provide directory listing as appropriate with names addresses, and telephone numbers of design consultant, Contractor, subcontractors, equipment suppliers, and nearest service representatives.

End of Section 210010

SECTION 210500 - FIRE PROTECTION

PART 1 - GENERAL

RELATED DOCUMENTS:

This section of the specifications describes requirements pertaining to Fire Protection. All work shall comply with Section 210010 - General Provisions Fire Protection, Mechanical and South Carolina Fire Protection Sprinkler Act, and NFPA 13 – 2010 Edition.

SCOPE:

This section of these specifications are intended to describe for furnishing labor, material, and equipment for the addition to the existing wet pipe automatic sprinkler system. See "Fire Protection Sprinkler System Specification Sheet" on the drawings for the basis of design.

This section of these specifications are intended to describe for furnishing labor, material, and equipment for the renovation of the existing wet pipe automatic sprinkler system.

In all areas, equipment and piping shall be installed so it will not interfere with the air conditioning, heating, ventilating and electrical systems that must occupy the same general areas.

Contractor shall design a renovation to the existing automatic wet system for the areas indicated on the drawings. All piping shall be sized based on hydraulic calculations using the existing diesel fire pump located in South Tower. The most recent fire pump test data (dated 05/23/2011) is a pump capacity of 500 gpm at 150 psi rated pressure, a churn pressure of 174 psi, and 143 psi at 150% flow rate.

COMPLIANCE WITH CODES:

The complete installation for the building shall be in accordance with code requirements of City of Columbia Fire Department, Division of State Fire Marshall, International Building Codes – 2009 Edition, South Carolina Fire Protection Sprinkler Systems Act (Title 40, Chapter 10), State Engineers Manual Section 5.13 (2001 OSE Manual, Revised February 17, 2004), and NFPA 13 – 2010 Edition.

SHOP DRAWINGS:

Detailed drawings, including proposed head layouts, shall be prepared by the Fire Protection Contractor. These drawings shall be submitted to the Engineer for their approval. Upon approval by the engineer, it shall be the responsibility of this contractor to submit the approved shop drawings to the Office of the State Fire Marshal for their approval. All approvals shall be received prior to starting work.

Upon completion of the indicated work, one (1) additional set of approved reproducible drawings showing the entire installation "as built" shall be furnished to the Owner for his files.

SEISMIC REQUIREMENTS:

Complete installation of fire protection system shall meet the seismic requirements including longitudinal bracing, sway bracing, and four way bracing as required.

PART 2 - PRODUCTS

Sprinkler heads shall be spray type, having 1/2" discharge orifice, with temperature ratings in accordance with Underwriter's specifications unless otherwise noted. Sprinkler heads shall be quick response extended coverage flat plate concealed pendent sprinklers with adjustable decorative/glass bulb type as manufactured by the Reliable Automatic Sprinkler Company, or equal as listed in 210010. All sprinkler heads in new metal soffits shall also be furnished with 5" expansion plate. All heads and expansion plates shall have a factory applied white finish.

The Contractor shall provide extra sprinkler heads and one (1) sprinkler wrench for each type of sprinkler provided in the building per NFPA 13 in the existing sprinkler head cabinet. Heads shall be properly apportioned as to temperature rating and types of heads used.

All piping smaller than 2-1/2" shall be schedule 40 steel piping.

PART 3 - EXECUTION

INSTALLATION:

Equipment, materials, installation, and workmanship shall be in accordance with NFPA 13 – 2010 Edition and the International Building Code.

FIELD TESTING AND FLUSHING:

Preliminary Tests: Hydrostatically test each system at 200 psig for a period of two hours. Flush piping in accordance with NFPA 13. Piping above new metal panel ceilings shall be tested, inspected, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for a formal inspection and tests.

End of Section 210500

SECTION 220010 - GENERAL PROVISIONS - PLUMBING

PART 1 - GENERAL

SCOPE:

Bids of work covered by each section of these specifications shall be based on the layout and equipment as shown and specified with only such approved substitutions as are allowed. Drawings show general arrangement of piping. Because of small scale of drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Contractor shall carefully investigate structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such fittings, traps, valves, and accessories as may be required to meet such conditions. Where locations make it necessary or desirable from Contractor's standpoint to make changes in arrangements or details shown on drawings, he may present suggestions for such changes and obtain Engineer's approval prior to making such changes.

CODES:

All work under this division shall be in strict compliance with "International Codes" and all applicable Codes and Regulations of the City of Columbia, South Carolina.

MATERIAL AND SHOP DRAWINGS:

Use only new materials and the standard product of a single manufacturer for each article of its type unless specifically mentioned otherwise. Materials and workmanship in the case of assembled items shall conform to the latest applicable requirements of NFPA, ASME, NEC, ASTM, AWWA, NEMA, and ANSI.

Schedule submittals to expedite work. Unless otherwise indicated in this Section, submittals shall be submitted within 30 days of date of Notice to Proceed. Provide six (6) copies of submittals for review and approval. Provide folders or binders for each submittal. All submittals shall be bound in a single volume. Partial lists will not be considered and will be returned to the Contractor. Identify Project, Contractor, subcontractor, supplier, manufacturer, pertinent drawing sheet and detail numbers, and associated specification section numbers. A table of contents shall be included in the front of the submittal with tabs indicating each section. Identify variations from requirements of Contract Documents.

Contractor responsibilities:
Review submittals prior to transmittal. Verify compatibility with field conditions and dimensions, product selections and designations, quantities, and conformance of submittal with requirements of Contract Documents. Return non-conforming submittals to preparer for revision rather than submitting to Engineer. Coordinate submittals to avoid conflicts between various items of work. Failure of Contractor to review submittals prior to transmittal to Engineer shall be cause for rejection. Incomplete, improperly packaged, and submittals from sources other than Contractor will not be accepted. Submittals not stamped APPROVED and signed by the Contractor will be returned to the Contractor.

Provide product data such as manufacturer's brochures, catalog pages, illustrations, which describe appearance, size, attributes, code and standard compliance, ratings, and other product characteristics. Provide all critical information such as reference standards, performance characteristics, capacities, finishes, dimensions, and required clearances. Submit only data which are pertinent. Mark each copy of manufacturer's standard printed data to identify products, models, options, and other data pertinent to project.

Engineer will review and return submittals with comments. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance. Promptly report any inability to comply with provisions. Revise and resubmit submittals as required within 15 days of return from Engineer. Make re-submittals under procedures specified for initial submittals. Identify all changes made since previous submittal.

Engineer Review:
Engineer will review submittals for sole purpose of verifying general conformance with design concept and general compliance with Contract Documents. Approval of submittal by Engineer does not relieve Contractor of responsibility for correcting errors which may exist in submittal or from meeting requirements of Contract Documents. After review, Engineer will return submittals marked as follows to indicate action taken:

- No Exception: Part of work covered by submittal may proceed provided it complies with requirements of Contract Documents. Final acceptance will depend upon that compliance. The term "approved" shall only indicate that there is no exception taken to the submittal.
- No Exception As Corrected: Part of work covered by submittal may proceed provided it complies with notations and corrections on submittal and requirements of Contract documents. Final acceptance will depend upon that compliance.
- Revise And Resubmit: Do not proceed with part of work covered by submittal including purchasing, fabricating, and delivering. Revise or prepare new submittal in accordance with notations and resubmit.

Samples:
Submit samples to illustrate functional and aesthetic characteristics of products with all integral parts and attachment devices. Include full range of manufacturer's standard finishes, indicating colors, textures, and patterns for A/E selection. Submit the number of samples specified in individual specification sections. One sample will be retained by A/E.

Items Requiring Submittal are as Follows:

Insulation

All items listed in MANUFACTURERS: Section of 220010

ASBESTOS:

Contractor shall refer to the bid documents for asbestos information on removal. At any time the Contractor encounters asbestos at locations other than those noted, he shall immediately stop work in the immediate area and suspend any further work until asbestos is removed. Contractor shall, upon discovery of asbestos, notify owner, or owner's representative, who shall direct the General Contractor for the removal of the asbestos, all in accordance with NESHAP (National Emission Standard for Hazardous Air Pollutants). Any form of asbestos removal or demolition shall be by Asbestos Removal Contractor. Engineer is not an "Owner or Operator" as defined under NESHAP.

Contractor is responsible for, and shall be aware of all state and federal laws pertaining to asbestos as well as NESHAP requirements.

LEAD FREE:

All solder, flux and pipe used in water system must be lead free. Lead free is defined as less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings.

PERMITS AND FEES:

Obtain permits, licenses, pay fees, etc. as required for performance of Contract. Arrange for necessary inspections required by governing authority and deliver certificates of approval to Architects or their representatives. File plans required by governing body.

DEFINITIONS:

In this division of the specifications and accompanying drawings, the following definitions apply:

Provide: To purchase, pay for, transport to the job site, unpack, install, and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware, and operations required for completion and operation.

Install (Installed): To furnish and install complete and ready for operation.

Furnish: To purchase, pay for, and deliver to the job site for installation by others.

The Plumbing Contractor is cautioned that "furnish" requires coordination with others. Such coordination costs shall be included as part of Plumbing Contractor's bid.

CUTTING AND PATCHING:

Cutting of walls, floors, roofs, partitions, and ceiling, required for proper installation of the systems shall be performed under this contract.

Cutting shall be done in a neat, workmanlike manner. No joist, beams, girders, columns, or other structural members may be cut without written permission from the Engineer. When possible, holes shall be saw-cut or core drilled neat to minimize patching.

Re-routing of existing pipes, insulation, etc. as required for installation of new system is included in this work. All work shall be done in accordance with specifications for new work of the particular type involved.

Patching shall be performed to match existing structures, exterior walls and roofs, and shall form watertight installation.

VERIFICATION OF DIMENSIONS, ETC.:

The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make in quadruplicate for approval before starting the work. Contractor shall install all equipment in a manner to avoid building interference.

COORDINATION WITH OTHER TRADES:

Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. Before beginning work under each section, inspect installed work of other trades and verify that such work is complete to the point where the installation may properly begin.

PROTECTION OF ADJACENT WORK:

Protect work and adjacent work at all times with suitable covering. All damage to work in place caused by Contractor shall be repaired and restored to original good and acceptable condition using same quality and kinds of materials as required matching and finishing with adjacent work.

FIRESTOPPING:

Provide firestopping for all mechanical penetrations through fire resistant walls and shaft enclosures, and floor, ceiling, and roof elements of fire resistant assemblies. Firestopping shall provide rating comparable to rating of structure it protects.

Firestopping materials currently classified with UL as "Through Penetration Firestop Systems".

Firestopping materials shall have been tested in accordance with UL 1479 "Fire Tests of Through Penetration Firestops".

CLEAN-UP:

At the completion of the contract work, all areas where work has been performed shall be left clean. All trash shall be removed from the site by the Contractor.

APPROVALS AND SUBSTITUTIONS:

Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, or type of construction which, in the judgment of the Engineer, expressed in writing, is equal to that specified.

Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified, shall be submitted for approval to the Engineer ten (10) days prior to bid date. Requests shall be accompanied by samples, descriptive literature and engineering information as necessary to fully identify and evaluate the product. No increase in the contract sum will be considered when requests are not approved.

AS-BUILT DRAWINGS:

The Contractor shall keep a record set of drawings on the job; and as construction progresses shall show the actual installed location of all items, material, and equipment on these job drawings. Indicate approved changes in red ink.

At the time of final completion, a corrected set of As-Built drawings shall be delivered to the Engineer. A final set of reproducible drawings with job information that reflects the actual installation shall be prepared by the Engineer and given to the Owner.

WARRANTY:

The Contractor for each section of the work under this division will furnish to the Owner a written warranty for the installation as installed, including controls and all other equipment covered under each section of the specifications, to perform in a quiet, efficient, and satisfactory manner with no more than normal service.

Each warranty shall extend for a period of one year following substantial completion and acceptance of construction. They shall be endorsed by the Contractor.

MANUFACTURERS:

In order to define requirements for quality and function of manufactured products, and requirements such as size, gauges, grade selection, color selections and like specifications requirements, the specifications as written hereinafter are based upon products of those manufacturers who are named hereinafter under various specifications for materials.

In addition to products of manufacturers named hereinafter in the specifications, equivalent products of the following named manufacturers will be acceptable under the base bid:

Insulation:

Owens Corning, Johns Manville, CertainTeed Corporation, Knauf Insulation

Pipe Hangers:

Cooper B-Line, Fee and Mason Manufacturing Company, Anvil International, Erico Caddy, Tolco a Division of Nibco

Floor Drains, Cleanouts, and Backwater Valve:

Wade, Inc., Zurn Industries, Inc., Josam Manufacturing Company, Jay R. Smith

Identification Items:

Seton Name Plate Company, W.H. Brady Company, Handley Industries, Inc.

PART 2 - PRODUCTS

FIRESTOPPING MATERIALS:

The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inches of water at the location of the test specimen for the time period equivalent to the fire resistance rating of the construction penetrated. Material shall be capable of curing in the presence of atmospheric

moisture to produce durable and flexible seal, and will form airtight and watertight bonds with most common building materials in any combination including cement, masonry, steel, and aluminum.

SLEEVES AND OPENINGS:

Provide UL certified fire stop sleeving system for all pipe penetrations through fire rated walls, floors, partitions, ceilings, floor-ceiling assemblies and roofs as tested under ASTM E814-02 "Standard Method of Fire Tests of Through Penetration Fire Stops".

PART 3 - EXECUTION

PIPE FITTINGS:

General: Provide complete systems of piping and fittings for all services as indicated. All pipe, valves, and fittings shall comply with American National Standards Institute, Inc. Code and/or local codes and ordinances. All fittings shall be domestically produced from domestic forgings. Cut pipe accurately to measurements established at building or site, and work into place without springing or forcing, properly clearing all windows, doors, and other openings or obstructions.

Excessive cutting or other weakening of building to facilitate piping installation will not be permitted. Piping shall line up flanges and fittings freely and shall have adequate unions and flanges so that all equipment can be disassembled for repairs. Test all piping prior to insulation or concealing.

PIPE:

All piping material shall be as specified in other sections of this division.

Fittings and Connections: All turns and connections shall be made with long radius fittings as scheduled hereinafter. No miter connections will be permitted in welded work.

Pipe joints shall be made in accordance with the following applicable specifications:

Make all solder joints with non-corrosive type flux 95 Percent tin and 5 percent antimony alloy solder.

Cast Iron Pipe: Joints in bell-and-spigot, cast iron soil, waste and vent pipes, or between cast iron soil waste and vent pipes shall be made using neoprene gaskets by Charlotte, or approved equal, by Wade or Tyler.

PIPE HANGERS, SUPPORTS AND INSERTS:

Pipe hangers, supports and inserts shall comply with Table 308.5 of the 2009 International Plumbing Code and be provided as follows:

All piping shall be supported by forged steel hangers or brackets suitably fastened to structural portion. Wall brackets shall be Fee & Mason Fig. No. 151. Provide lock nuts on all adjustable hanger assemblies.

PIPE SIZE - INCHES

	1/2 – 2	2-1/2 – 4	6 – Up	Wall Plate Hanger
Grinnel	104	260	171	139
Fee & Mason 199	239	170	302	
Elcen	92	12	15	---

Hanger or Support Spacing (unless specified different hereinafter):

Hanger or support maximum spacing shall be as follows:

Copper Pipe:

Nominal Pipe Size – Inches	Maximum Span - Feet
1-1/4" and under	6'
1-1/2" and above	10'

Cast Iron Pipe:

Length of Pipe – Feet	Maximum Span - Feet
5'- 0"	5'
10'- 0"	10'

Size hangers on insulated piping to permit insulation and saddles to pass full size through hanger.

On Cast Iron Soil Pipe (horizontal):

At least one hanger on each full length of pipe, close to hub where possible and at least one within 24 inches of each fitting, and wherever else required to prevent tendency toward deflection due to load. Hanger at upper angle of each drop. Where multiple fittings are used, hangers shall be located not more than 4 feet on centers and adjacent to hubs on fittings.

INSULATION SHIELDS:

Provide all insulated piping with 10-inch long (16 gauge) protective galvanized sheet metal shields extending 120 degrees around bottom of insulated pipe.

FLOOR, WALL AND CEILING PLATES:

Where pipes pass through floors, finished walls, or ceilings, fit with chromium plate cast brass plates or chromium plated steel plates as specified hereinafter. Plates shall be large enough to completely close hole around pipes, and shall be square, octagonal, or round, with least dimension not less than 1-1/2 times larger than diameter of pipe. Secure plates in an approved manner. Plates shall be Beaton-Caldwell No. 3A for floors and No. 40 for walls and ceilings.

CLEANING:

All surfaces on metal, pipe, insulation covered surfaces, and other equipment furnished and installed under this division of the specifications shall be thoroughly cleaned of grease, scale, dirt and other foreign material.

TESTING (PIPING):

Upon completion of each system of work under this division, and at a designated time, all piping shall be pressure tested for leaks in the presence of the owner. Owner shall be notified five days before testing is to be conducted and all tests shall be conducted in the presence of the owner. All equipment required for test shall be furnished by contractor at his expense. All tests shall be performed as specified hereinafter. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated at no additional cost to owner. Make tight any leaks. Repeat tests until system is proven tight. Caulking of leaks will not be permitted. All equipment not capable of withstanding the test pressure shall be valved off during the test.

Drainage System: Drainage and venting system shall be tested in such a manner that cast iron soil pipe will not be subjected to excessive pressure. Testing of any portion of this system shall be executed by plugging all necessary openings of that portion of system being tested and filling with water to a height of not less than ten feet above highest floor, or a pump may be used to maintain an equivalent pressure. Test pressure shall be maintained to thirty minutes when using pump method. When using water column method, test period shall also be thirty minutes, and water level shall not drop. Hot poured joints shall not be tested with more than eighty feet head of water. No tests shall be made during freezing weather.

Cold Water Piping: Upon completion of rough-in and before setting fixtures, entire hot and cold water systems shall be tested at a hydrostatic pressure of 1-1/2 times operating pressure, but not less than 150 psig, and be proved tight at this pressure. Where a portion of water system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system. Water used for testing shall be from a potable source of supply.

OPERATION AND MAINTENANCE INSTRUCTIONS, AND MAINTENANCE MANUAL:

Upon completion of work, and at a time designated by the engineer, a competent employee of the contractor shall be provided to instruct a representative of the owner in the operation and maintenance of the system.

Minimum instruction period shall be:

- Plumbing System - 1/2 day

Maintenance Manuals: The contractor shall compile and bind five (5) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. These instructions shall be delivered through the general contractor to the engineer for approval prior to final inspection.

Instructions shall include:

- Warranty letter signed by the Mechanical Contractor.
- Index for each section with each section properly identified.
- Complete equipment list with model and serial numbers.
- Copy of one complete, approved submittal for each equipment section.
- Description of each system, including manufacturer's literature for all items.

- Start-up and shut-down description for each system.
- Suggested operating and maintenance instructions with frequency of maintenance indicated.
- Parts list for all items of equipment.
- Name, address, and telephone number of nearest sales and service organization for all items of equipment.

Manuals shall be 8-1/2 x 11 inch text pages bound in three ring expansion binders with a hard durable cover with clear plastic pocket on front for title page. Prepare binder covers with printed subject title of manual, title of project, date, and volume number when multiple binders are required. Printing shall be on face and spine. Provide a table of contents for each volume. Internally subdivide the binder contents with divider sheets with typed tab titles under reinforced plastic tabs. Provide directory listing as appropriate with names addresses, and telephone numbers of design consultant, Contractor, subcontractors, equipment suppliers, and nearest service representatives.

End of Section 220010

SECTION 220500 - PLUMBING:

PART 1 - GENERAL

WORK INCLUDED:

General Requirements: This Section of the Specifications and related drawings describe requirements pertaining to plumbing work including applicable insulation in separate Section 220700. All work shall conform to Section 220010, General Provisions - Plumbing. Work includes, but is not necessarily limited to:

1. All drains noted or specified.
2. Cold water make-up systems.
3. Storm drainage system.
4. Other plumbing indicated on drawings, specified herein, or required for complete and proper installation in accordance with applicable codes and regulations.
5. Insulation.

Upon completion of work, all fixtures, devices, etc. for use by persons with disabilities shall meet all requirements as set forth by the Americans with Disabilities Act (ADA).

PART 2 - PRODUCTS

SOIL, WASTE, STORM DRAIN AND VENT PIPING AND FITTINGS:

Materials shall conform to the following specifications requirements:

Construct new soil, storm drain, waste and vent piping, 2 inches and larger in diameter that is installed above floor slabs with standard weight, asphaltum-coated, cast iron, bell-and-spigot type, soil pipe and fittings. Pipe and fittings shall be labeled with the Cast Iron Soil Pipe Institute's Collective Trademark of quality and permanence as illustrated in ASTM Standard A-74, which indicates that it complies with this standard. No import pipe will be allowed.

SUPPLY PIPING AND FITTINGS:

Materials for supply piping and fittings shall conform to the following specification requirements:

All water piping aboveground shall be seamless hard drawn type L copper tubing, ASTM B 88, with wrought copper ASA B16.22, fittings, Class No. 150.

Valves: Materials for valves shall conform to the following specification requirements:

All valves shall be ball valves and shall be two-piece bronze body, full port, chrome ball, RTFE seats, with adjustable packing, rated for 600 psig minimum working pressure, meeting WWV-35 and MSS-SP110.

CLEANOUTS:

Provide cleanouts as follows:

General use in Finished Floor - ZN-1400-3 C.I. floor cleanout with seriated cut-off ferrule lead seal plug adjustable Nikaloy square scoriated frame and cover.

All cleanouts shall be as manufactured by Zurn Industries, Inc., or approved equal by Jay R. Smith or Josam.

DRAINS:

Provide floor drains of manufacturer's standard size at locations indicated on drawings. Construct drains of cast iron with polished brass strainer. Floor drains shall be as indicated on drawings. Drains shall be as manufactured by Zurn Industries, Inc., or approved equal by Jay R. Smith or Josam.

PART 3 - EXECUTION

EXISTING CONDITIONS:

Verify locations and inverts of existing and proposed pipes. Location of structural elements, locations and sizes of chases, type and method of construction of floors, walls, partitions, etc.

Drawings do not indicate all offsets, fittings, and specialties. Examine other drawings, investigate conditions to be encountered and arrange work accordingly, furnishing required fittings, valves, specialties, etc. without extra charge. Where conditions necessitate rearrangement, submit for approval sketches showing proposed arrangement.

INSTALLATION:

GENERAL:

Protect pipe openings and drains by plugs or caps. Duct tape will not be acceptable. Clean all stoppages.

Unless otherwise shown, install piping concealed, straight, without sags or pockets and graded for drainage. Cut pipe ends square and ream. Before assembly, clean dirt, scale and chips.

Provide clearance between pipe and building structure so pipes can expand without damage to building structure.

Schedule meetings with other trades before and during installation to avoid conflicts and ensure that pipes and equipment are installed in best manner, taking into consideration headroom, maintenance, appearance and replacement.

SOIL, WASTE, SEWER AND VENT PIPING:

Install sewer and water pipes in separate trenches with grades uniform to provide solid bearing. Dig bell holes at hubs. Piping through or under footings shall be provided with a pipe sleeve or relieving arch.

Run horizontal pipe, graded uniformly, not less than 1/4" per foot for pipes 2-1/2" and smaller; and 1/8" per foot for larger pipes. Offset as required to pass obstacles.

Change size by reducing fittings. Change directions by 45-degree wyes and long-sweep bends. Use short-sweep bends only with written approval. No pipe shall be drilled, tapped, or welded. Saddle hubs and bands, tapped tees, and crosses will not be approved.

Upon completion of tests and inspections, backfill with approved material, placed and tamped to prevent settlement.

WATER PIPING:

Unless otherwise indicated, run hot and cold water piping concealed, and uniformly pitched to ensure venting and drainage. Install drain valves at low points.

TRAPS:

Provide each fixture with a trap when connection to drainage system is required. Place each trap as near to fixture as possible. No fixture shall be double trapped. Traps installed on bell-and-spigot pipe shall be cast iron. Traps installed on threaded pipe shall be recess drainage pattern.

CLEANOUTS:

Provide an easily accessible cleanout where indicated on drawings. Cleanouts shall be of the same nominal size as pipe in which they are installed, up to 4 inches; and not less than 4 inches for larger sizes. A cleanout shall consist of a long sweep 1/4 bend or one or two 1/8 bends. Maximum spacing of cleanouts shall be one hundred feet.

DRAINS:

Provide floor drains of manufacturer's standard size at locations indicated on drawings. Carefully set drains to grade to provide drainage of surrounding area, and trap.

SANITARY SEWER SYSTEM:

Work includes providing of all materials and equipment, and performing all labor necessary to construct sewers and connections, including all pipe, wye branches, joint material, and appurtenances which may be reasonably implied as necessary to complete work shown on drawings or specified herein.

End of Section 220500

SECTION 220700 – PLUMBING INSULATION

PART 1 - GENERAL

WORK INCLUDED:

General Requirements: This section shall include all insulation as required for installation on all items as specified hereinafter and/or as indicated. **All insulations shall be installed in a workmanlike manner by qualified workers in the employment of an independent insulation contractor**. Costs of insulation shall be included as part of work by contractor as applicable to his section of work. No separate bid is to be included for insulation work.

Fire hazard classification for all material shall not exceed flame spread of 25 and smoke development of 50 as classified by Underwriters Laboratories under Test Method ASTM E-84 and acceptable under NFPA Standards. This is to apply to the complete system and be a composite rating of insulation material with jacket or facings, vapor barrier, joint sealing tapes, mastic and fittings.

Prior to commencing any work, submit data sheets for engineer's approval of all material proposed to be used on this project.

PART 2 - PRODUCTS

ABOVE GROUND INDOOR PIPING:

Pipe Insulation:

All water piping shall be insulated with heavy density fiberglass with all-service jacket Owens-Corning Double Self-Sealing Lap, ASJ/SSL-II, one piece, to be used on all lines above and below ambient temperature from 0°F to 850°F.

PIPE INSULATION THICKNESS:

Piping for the following systems shall be insulated to the thickness listed:

Item	Insulation Thickness (Inches)
Fiberglass K = .24	
Cold Pipes:	
Cold Water (Domestic)	1"
Storm Drainage	1"

PART 3 - EXECUTION

PIPE INSULATION:

All insulation shall be applied to clean, dry surfaces butting all sections firmly together and finishing as specified hereinafter.

All vapor barriers shall be sealed, and shall be continuous throughout. No staples shall be used on any vapor barrier jacket unless sealed with vapor barrier coating or vapor barrier tape.

Insulation of all insulated lines shall be interpreted as including all pipe, valves, fittings and specialties comprising the lines, except flanged unions and screwed unions on hot piping.

Where sectional insulation is not practical, the proper insulation cement or block insulation shall be utilized by forming it to the applied surface.

Insulation over fittings and soil pipe hubs shall be of equal thickness as the adjoining pipe insulation.

Pipe Insulation Protection: Direct contact between pipe and hangers shall be avoided. Hanger shall pass outside of a sheet metal protection saddle which shall cover a section of high density insulation (cellular glass or calcium silicate), of sufficient length to support the weight of the pipe without crushing the insulation. The vapor barrier shall be continuous behind the saddle or shall be lapped over the saddle and securely cemented thereto.

All pipe covering shall be furnished with self-seal lap and 3" wide butt joint strips. The release paper is pulled from adhesive edge, pipe covering closed tightly around pipe and self-seal lap rubbed hard in place with the blunt edge of an insulation knife. This procedure applied to longitudinal as well as circumferential joints. Staple all longitudinal and circumferential joints with 9/16" staples 6" on center and seal over all staples with Childers CP-30 vapor barrier coating. Care shall be taken to keep jacket clean as it is the finish on all exposed work. All adjoining insulation sections shall be firmly butted together before butt joint strip is applied, and all chilled water and cold water service lines shall have vapor barrier coating thoroughly coated to pipe at butt joints and at all fittings. All fittings, valve bodies, unions, and flanges shall be finished as follows:

Apply fiberglass inserts to all cold water fittings in conjunction with Proto PVC Fitting Covers. Seal cold applications as recommended by the manufacturer.

End of Section 220700

SECTION 230010 - GENERAL PROVISIONS - HVAC

PART 1 - GENERAL

SCOPE:

Bids of work covered by each section of these specifications shall be based on the layout and equipment as shown and specified with only such approved substitutions as are allowed. Drawings show general arrangement of ductwork and piping. Because of small scale of drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Contractor shall carefully investigate structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such fittings, traps, valves, and accessories as may be required to meet such conditions. Where locations make it necessary or desirable from Contractor's standpoint to make changes in arrangements or details shown on drawings, he may present suggestions for such changes and obtain Engineer's approval prior to making such changes.

CODES:

All work under this division shall be in strict compliance with "International Codes" and all applicable Codes and Regulations of the State of South Carolina.

HEATING AND AIR CONDITIONING CONTRACTOR QUALIFICATIONS - SPECIAL STANDARDS OF RESPONSIBILITY:

Heating and Air Conditioning Contractor's Qualifications:

1. A qualified firm that has not less than five (5) years experience in the installation of hydronic heating and cooling systems.

2. A qualified firm that has successfully completed hydronic heating and cooling systems installation for a minimum of three (3) projects over a period of six (6) years and where the scope of heating and air conditioning work was over $1,000,000.00.

3. A qualified firm that has ASME Section 9 certified welders on staff regularly employed for hydronic piping installation.

MATERIAL AND SHOP DRAWINGS:

Use only new materials and the standard product of a single manufacturer for each article of its type unless specifically mentioned otherwise. Materials and workmanship in the case of assembled items shall conform to the latest applicable requirements of NFPA, ASME, NEC, ASTM, AWWA, NEMA, and ANSI.

Schedule submittals to expedite work. Unless otherwise indicated in this Section, submittals shall be submitted within 30 days of date of Notice to Proceed. Provide six (6) copies of submittals for review and approval. Provide folders or binders for each submittal. All submittals shall be bound in a single volume. Partial lists will not be considered and will be returned to the Contractor. Controls may be submitted separately and shall be submitted no later than 60 days of notice to proceed. Identify Project, Contractor, subcontractor, supplier, manufacturer, pertinent drawing sheet and detail numbers, and associated specification section numbers. A table of contents shall be included in the

front of the submittal with tabs indicating each section. Identify variations from requirements of Contract Documents.

Contractor responsibilities:
Review submittals prior to transmittal. Verify compatibility with field conditions and dimensions, product selections and designations, quantities, and conformance of submittal with requirements of Contract Documents. Return non-conforming submittals to preparer for revision rather than submitting to Engineer. Coordinate submittals to avoid conflicts between various items of work. Failure of Contractor to review submittals prior to transmittal to Engineer shall be cause for rejection. Incomplete, improperly packaged, and submittals from sources other than Contractor will not be accepted. Submittals not stamped APPROVED and signed by the Contractor will be returned to the Contractor.

Where required by specifications or otherwise needed, prepare drawings illustrating portion of work for use in fabricating, interfacing with other work, and installing products. Prepare ¼" per foot scale drawings of all mechanical rooms when substituting items of equipment that are not the basis for design. All equipment submitted shall be of adequate size and physical arrangement to allow unobstructed access when installed, for routine maintenance, coil removal, shaft removal, motor removal and other similar operations. Contract Drawings shall not be reproduced and submitted as shop drawings. Drawings shall be 8-1/2 by 11 inches minimum and 24 by 36 inches maximum. Title each drawing with Project name and reference the sheet the drawing corresponds to.

Provide product data such as manufacturer's brochures, catalog pages, illustrations, diagrams, tables, performance charts, and other material which describe appearance, size, attributes, code and standard compliance, ratings, and other product characteristics. Provide all critical information such as reference standards, performance characteristics, capacities, power requirements, wiring and piping diagrams, controls, component parts, finishes, dimensions, and required clearances. Submit only data which are pertinent. Mark each copy of manufacturer's standard printed data to identify products, models, options, and other data pertinent to project.

Control diagrams: Show relative positions of each component as a system diagram. Provide points list, wiring diagram and schedule of all products and components used in system.

Engineer will review and return submittals with comments. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance. Promptly report any inability to comply with provisions. Revise and resubmit submittals as required within 15 days of return from Engineer. Make re-submittals under procedures specified for initial submittals. Identify all changes made since previous submittal.

Engineer Review:
Engineer will review submittals for sole purpose of verifying general conformance with design concept and general compliance with Contract Documents. Approval of submittal by Engineer does not relieve Contractor of responsibility for correcting errors which may exist in submittal or from meeting requirements of Contract Documents. After review, Engineer will return submittals marked as follows to indicate action taken:

- No Exception: Part of work covered by submittal may proceed provided it complies with requirements of Contract Documents. Final acceptance will depend upon that compliance. The term "approved" shall only indicate that there is no exception taken to the submittal.
- No Exception As Corrected: Part of work covered by submittal may proceed provided it complies with notations and corrections on submittal and requirements of Contract documents. Final acceptance will depend upon that compliance.
- Revise And Resubmit: Do not proceed with part of work covered by submittal including purchasing, fabricating, and delivering. Revise or prepare new submittal in accordance with notations and resubmit.

Samples:
Submit samples to illustrate functional and aesthetic characteristics of products with all integral parts and attachment devices. Include full range of manufacturer's standard finishes, indicating colors, textures, and patterns for A/E selection. Submit the number of samples specified in individual specification sections. One sample will be retained by A/E.

Items Requiring Submittal are as Follows:

Test and Balance
Insulation

All items listed in MANUFACTURERS: Section of 230010

ASBESTOS:

Contractor shall refer to the bid documents for asbestos information on removal. At any time the Contractor encounters asbestos at locations other than those noted, he shall immediately stop work in the immediate area and suspend any further work until asbestos is removed. Contractor shall, upon discovery of asbestos, notify owner, or owner's representative, who shall direct the General Contractor for the removal of the asbestos, all in accordance with NESHAP (National Emission Standard for Hazardous Air Pollutants). Any form of asbestos removal or demolition shall be by Asbestos Removal Contractor. Engineer is not an "Owner or Operator" as defined under NESHAP.

Contractor is responsible for, and shall be aware of all state and federal laws pertaining to asbestos as well as NESHAP requirements.

LEAD FREE:

All solder, flux and pipe used in water system must be lead free. Lead free is defined as less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings.

AMERICANS WITH DISABILITIES ACT:

All items or work under this division of the specifications shall comply with guidelines as set forth in the Americans With Disabilities Act.

PERMITS AND FEES:

Obtain permits, licenses, pay fees, etc. as required for performance of Contract. Arrange for necessary inspections required by governing authority and deliver certificates of approval to Architects or their representatives. File plans required by governing body.

DEFINITIONS:

In this division of the specifications and accompanying drawings, the following definitions apply:

Provide: To purchase, pay for, transport to the job site, unpack, install, and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware, and operations required for completion and operation.

Install (Installed): To furnish and install complete and ready for operation.

Furnish: To purchase, pay for, and deliver to the job site for installation by others.

The Mechanical Contractor is cautioned that "furnish" requires coordination with others. Such coordination costs shall be included as part of Mechanical Contractor's bid.

CUTTING AND PATCHING:

Cutting of walls, floors, roofs, partitions, and ceiling, required for proper installation of the systems shall be performed under this contract.

Cutting shall be done in a neat, workmanlike manner. No joist, beams, girders, columns, or other structural members may be cut without written permission from the Engineer. When possible, holes shall be saw-cut or core drilled neat to minimize patching.

Re-routing of existing pipes, insulation, etc. as required for installation of new system is included in this work. All work shall be done in accordance with specifications for new work of the particular type involved.

Patching shall be performed to match existing structures, exterior walls and roofs, and shall form watertight installation.

VERIFICATION OF DIMENSIONS, ETC.:

The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make in quadruplicate for approval before starting the work. Contractor shall install all equipment in a manner to avoid building interference.

COORDINATION WITH OTHER TRADES:

Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. Before beginning work under each section, inspect installed work of other trades and verify that such work is complete to the point where the installation may properly begin.

Where equipment supplied by an approved manufacturer is substituted for the specified equipment, the Contractor will be responsible for coordinating any changes required in his work or other trades work, including but not limited to electrical requirements, structural steel requirements and space requirements. Any additional costs required to make changes to other trades work shall be borne by this contractor.

PROTECTION OF ADJACENT WORK:

Protect work and adjacent work at all times with suitable covering. All damage to work in place caused by Contractor shall be repaired and restored to original good and acceptable condition using same quality and kinds of materials as required matching and finishing with adjacent work.

EXISTING EQUIPMENT AND MATERIALS:

All items of equipment removed under this section of the specifications shall become the property of this Contractor shall be promptly removed from this site.

FIRESTOPPING:

Provide firestopping for all mechanical penetrations through fire resistant walls and shaft enclosures, and floor, ceiling, and roof elements of fire resistant assemblies. Firestopping shall provide rating comparable to rating of structure it protects.

Firestopping materials currently classified with UL as "Through Penetration Firestop Systems".

Firestopping materials shall have been tested in accordance with UL 1479 "Fire Tests of Through Penetration Firestops".

CLEAN-UP:

At the completion of the contract work, all areas where work has been performed shall be left clean. All trash shall be removed from the site by the Contractor.

APPROVALS AND SUBSTITUTIONS:

Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, or type of construction which, in the judgment of the Engineer, expressed in writing, is equal to that specified.

Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified, shall be submitted for approval to the Engineer ten (10) days prior to bid date. Requests shall be accompanied by samples, descriptive literature and engineering information as necessary to fully identify and evaluate the product. No increase in the contract sum will be considered when requests are not approved.

The Contractor shall bear the burden and cost of coordinating with all trades any changes in work required by substitutions, including but not limited to electrical connections, additional components required, service clearance, etc.

AS-BUILT DRAWINGS:

The Contractor shall keep a record set of drawings on the job; and as construction progresses shall show the actual installed location of all items, material, and equipment on these job drawings. Indicate approved changes in red ink.

At the time of final completion, a corrected set of As-Built drawings shall be delivered to the Engineer. A final set of reproducible drawings with job information that reflects the actual installation shall be prepared by the Engineer and given to the Owner.

WARRANTY:

The Contractor for each section of the work under this division will furnish to the Owner a written warranty for the installation as installed, including controls and all other equipment covered under each section of the specifications, to perform in a quiet, efficient, and satisfactory manner with no more than normal service.

Each warranty shall extend for a period of one year following substantial completion and acceptance of construction. They shall be endorsed by the Contractor. Refrigeration compressors shall have a five (5) year warranty.

MANUFACTURERS:

In order to define requirements for quality and function of manufactured products, and requirements such as size, gauges, grade selection, color selections and like specifications requirements, the specifications as written hereinafter are based upon products of those manufacturers who are named hereinafter under various specifications for materials.

In addition to products of manufacturers named hereinafter in the specifications, equivalent products of the following named manufacturers will be acceptable under the base bid:

Air Handling Units:

McQuay International, The Trane Company

Fan Coil Units:

Environmental Technologies

Ductless Split Heat Pumps:

Mitsubishi, Daikin

Air Filters:

Farr Filter Company, Flanders Filters, American Air Filter Company

Energy Recovery Air Handling Unit:

Munters, SEMCO Inc.

Variable Air Volume Boxes:

Environmental Technologies, The Trane Company

Air Distribution:

Metal Industries, Price Company, Titus Manufacturing Company, Nailor Industries, Anemostat Products Division, Krueger, J & J Register Co., Carnes Company, Tuttle and Bailey

Fans:

Greenheck Fan Corporation, Loren Cook Company, Breidert/Jenn Fans, Carnes Company, ACME, PennBarry, Twin City Blower

Dampers:

Ruskin Manufacturing Company, NCA Manufacturing, Safe Air/Dowco, Inc., Cesco Products, Inc., Leader Industries, Pottorff, Arrow United, Young Regulator

Fire and Smoke Dampers:

Ruskin Manufacturing Company, NCA Manufacturing, Safe Air/Dowco, Inc., Cesco Products, Inc., Leader Industries, Pottorff, Prefco Products

Louvers:

Ruskin Manufacturing Company, NCA Manufacturing, Safe Air/Dowco, Inc., Cesco Products, Inc., Leader Industries, Pottorff, Arrow United

Spiral and Oval Duct and Fittings:

Eastern Sheet Metal, Lindab, Semco, Inc., United Sheet Metal, Spiral Pipe of Texas, Hamlin Sheet Metal, EHG Duct, Dixie Sheet Metal, Silversheet Enterprises

Adhesives and Sealants:

Childers, Hardcast, TACC International, MEI Industries, McGill Airseal Corporation, Duro Dyne, Ductmate Industries, Design Polymerics

Seismic and Vibration Equipment:

Mason Industries, Vibration Mountings & Controls, Inc., Amber/Booth Company, Vibration Eliminator Co., Kinetics Noise Control

Pumps:

Taco, Inc., Bell and Gossett Company

Automatic Flow Control Valves:

Flow Design Inc, Griswold Controls, US Industrial Sourcing

Hot Water Convertors:

Bell and Gossett Company, Richmond Engineering Company, Taco, Inc.

Condensate Units:

Bell and Gossett Company, ITT Industries, Domestic Pump Company, Shipco Pumps, Sarco Company

Steam Specialties:

ITT Industries, Armstrong, Muller Company, Crane Company, Sarco Company, Watson McDaniel

Hydronic Unit Heaters:

McQuay International, The Trane Company

Temperature and Air Pressure Gages:

Dwyer Instruments, Weiss Instruments, H.O. Trerice Company, Ellison Draft Gauge Company, Inc., Weksler Instrument

Insulation:

Owens Corning, Johns Manville, CertainTeed Corporation, Knauf Insulation

Temperature Controls:

Johnson Controls

Safety Valves:

Watts Regulator Company, McDonnell and Miller, Inc., H.A. Thrush & Company.

Control Valves:

Johnson Controls, Belimo, Erie

Valves:

Crane Company, Grinnell Company, O.I.C. Valve Co., Chase Brass & Copper Company, Rockwell Manufacturing Company, Consolidated Brass Company, Hammond, Nibco.

Pipe Hangers:

Cooper B-Line, Fee and Mason Manufacturing Company, Anvil International, Erico Caddy, Tolco a Division of Nibco

Identification Items:

Seton Name Plate Company, W.H. Brady Company, Handley Industries, Inc.

PART 2 - PRODUCTS

PAINTING:

Furnish touch up paint supplied by equipment manufacturer.

Coat ferrous metal surfaces that do not have factory painting or galvanizing with one coat of Sherwin Williams high heat aluminum paint.

CONCRETE EQUIPMENT FOUNDATIONS:

Use 3000-psi "batch plant" concrete or approved "precast" reinforced concrete foundations.

NAME PLATES:

All equipment provided under this division shall be labeled with a Bakelite nameplate 1" x 3" minimum with 3/8" minimum height lettering as manufactured by Seton Name Plate Company. See filter nameplate requirement below.

VALVES:

All valves provided under each section shall be of a single manufacturer unless otherwise specified. Leave packing for all valves in good condition, replacing as necessary for completion of work. Packing is to be of an approved material suitable for required service. Valve manufacturer and pressure rating shall be cast on side of valve body. Each threaded valve shall have a union installed adjacent to it. All valves shall be of listed manufacturer as scheduled hereinafter in other sections of Division 15.

BELT GUARDS:

Provide all V-belt drives with belt guards. They shall cover all moving parts, and shall have 4-inch clearance between belt and guards; also allowing for motor travel on sliding rail. Guards shall be constructed of 1-1/2" x 1-1/2" x 3/16" galvanized angle iron and with all sides covered with 22 gauge, 2" x 1", diamond shaped expanded galvanized metal. Guards shall be well braced to avoid warping, and shall be supported from floor and equipment. Construct guard so that it can be easily removed and replaced.

EQUIPMENT ACCESSORIES:

Where flexible couplings are required, they shall be similar to Faulk Corporation, Type F Steelflex. All couplings shall be provided with guards.

Lubrication: Provide oil level gauges, grease cups, and grease gun fittings for all equipment bearings as recommended by equipment manufacturer. All grease gun fittings shall be of a uniform type.

FILTERS:

Provide one new set of MERV 8 pleated filters in each unit at final completion. Provide the Owner one replacement set of filters with a complete filter list indicating unit tag and size and quantity of filters needed. At each filter door provide a Bakelite nameplate 1" x 3" minimum with 1/8" minimum height lettering as manufactured by Seton Name Plate Company, that indicates the size and quantity of each filter required in that particular unit.

VALVE TAGS AND SCHEDULE:

Provide separate typewritten list of all valves, giving number and use and control of each, on a small scale drawing outlining the general run of pipe lines and showing the location of valves for each section of work. Pipe lines in diagram shall be color coded to match piping. Drawings to be framed under glass and located in the equipment room. Provide a 1-1/2" diameter round brass numbered tag secured to each valve with "S" hook, Style P-250 BL as manufactured by Seton Name Plate Company, or equal.

THERMOMETERS FOR PIPING:

Thermometers, except where otherwise specifically noted on drawing, shall be equal to Weiss Instruments model DVU35.

All thermometers shall be digital solar powered with a stem assembly suitable for mounting in a threaded pipe well. The thermometer shall have an adjustable angled body.

Thermometer Wells:

Thermometer wells shall be provided at all points indicated on the drawing. Thermometer wells shall be designed to hold an engraved stem thermometer. The wells shall be made of heavy brass and shall be approximately six inches long, shall project two inches into the pipe and shall have dust protecting caps and chains. Pipes smaller than 2-1/2 inches in size shall be enlarged at the points where the wells are installed. Wells shall be set vertical or at an angle so as to retain oil.

PRESSURE GAUGES:

Pressure gauges shall be installed as indicated on the drawing. Pressure gauges shall be equal to Weiss model LF401 liquid filled with stainless steel bayonet and case. Except as otherwise specified or shown, gauges shall have 4" dials.

Each gauge shall be equipped with a brass needle valve.

Each steam gauge shall be equipped with syphon.

Gauges shall be installed in such a manner so as to be accessible and easily read. Range of gauge for each particular point of application shall be selected so that pointer is approximately in midpoint of scale under normal operating conditions.

FIRESTOPPING MATERIALS:

The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inches of water at the location of the test specimen for the time period equivalent to the fire

resistance rating of the construction penetrated. Material shall be capable of curing in the presence of atmospheric moisture to produce durable and flexible seal, and will form airtight and watertight bonds with most common building materials in any combination including cement, masonry, steel, and aluminum.

SLEEVES AND OPENINGS:

Provide UL certified fire stop sleeving system for all pipe penetrations through fire rated walls, floors, partitions, ceilings, floor-ceiling assemblies and roofs as tested under ASTM E814-02 "Standard Method of Fire Tests of Through Penetration Fire Stops".

SEISMIC RESTRAINTS:

Seismic restraints shall be provided per International Building Code Chapter 16 for Category C Buildings (See Code Compliance on Drawing Cover Sheet), specification section 230548 and the drawings.

PART 3 - EXECUTION

CONCRETE EQUIPMENT FOUNDATIONS:

Consult ASHRAE: A Practical Guide to Seismic Restraint, Chapter 6 for specific reinforcement and anchoring details, with respect to pad size and seismic forces. Unless otherwise noted, set all floor mounted and "on-grade" mounted equipment on 6" high concrete foundation pads. Concrete foundations shall be reinforced with #4 bars - 12" o.c. both ways, or as directed by A Practical Guide to Seismic Restraint. Pads shall be approximately 6" larger than equipment base, and have 1" x 1" chamfer on all edges. Pads shall have carborundum brick rubbed finish. Surface finish shall be uniformly smooth. Concrete floor shall be rough and foundation doweled to floor per A Practical Guide to Seismic Restraint.

PIPE FITTINGS:

General: Provide complete systems of piping and fittings for all services as indicated. All pipe, valves, and fittings shall comply with American National Standards Institute, Inc. Code and/or local codes and ordinances. All fittings shall be domestically produced from domestic forgings. Cut pipe accurately to measurements established at building or site, and work into place without springing or forcing, properly clearing all windows, doors, and other openings or obstructions.

Excessive cutting or other weakening of building to facilitate piping installation will not be permitted. Piping shall line up flanges and fittings freely and shall have adequate unions and flanges so that all equipment can be disassembled for repairs. Test all piping prior to insulation or concealing.

All welded pipe and fittings shall be delivered to job with machine beveled ends. Where necessary, beveling may be done in field by gas torch. In which case, surfaces shall be thoroughly cleaned of scale and oxidation after beveling.

WELDING:

All welding shall be done by certified welders. Welded pipe shall have flanges at valves and elsewhere as required to permit disassembly for maintenance. Tests and reports shall be as follows:

Qualification test of each welder prior to beginning of construction.

One sample of weld of each welder's work selected at random by Engineer during construction period.

Procedure for making tests of welds shall be as outlined in Section 9 of ASME Boiler Construction Code. These tests shall be made by an approved testing laboratory, and a report furnished to Engineer. Report on qualification tests shall be made for gas welding and electric arc welding on steel in horizontal fixed position. A testing laboratory representative shall witness making of welds made for qualification tests. All costs of testing of welds shall be paid by Contractor.

PIPE:

All piping material shall be as specified in other sections of this division.

Fittings and Connections: All turns and connections shall be made with long radius fittings as scheduled hereinafter. No miter connections will be permitted in welded work.

Pipe joints shall be made in accordance with the following applicable specifications:

Make up flanged joints with ring-type gaskets, 1/16 inch thick.

Weld-O-Lets, or similar approved fittings, may be used if branch pipe is less than one-half the size of the main. In all other cases, welding fittings shall be used. All welded piping shall be as specified hereinbefore.

Make all solder joints with non-corrosive type flux 95 Percent tin and 5 percent antimony alloy solder.

SLEEVES:

Provide all sleeves in floors, beams, wall, roof, etc. as required for installing work of this division unless otherwise specified hereinafter. Size sleeves for insulated pipe to accommodate both pipe and insulation. Construct vertical sleeves in connection with concealed piping of 22 gauge galvanized iron. Sleeves thru fire-rated assemblies shall be firestopped as specified herein and insulation shall not pass thru sleeve unless material complies with firestopping specified.

PIPE HANGERS, SUPPORTS AND INSERTS:

Pipe hangers, supports and inserts shall comply with Table 305.4 of the 2006 International Mechanical Code and be provided as follows:

All piping shall be supported by forged steel hangers or brackets suitably fastened to structural portion. Wall brackets shall be Fee & Mason Fig. No. 151. Provide lock nuts on all adjustable hanger assemblies.

PIPE SIZE - INCHES

	1/2 – 2	2-1/2 – 4	6 – Up	Wall Plate Hanger
Grinnel	104	260	171	139
Fee & Mason 199	239	170	302	
Elcen	92	12	15	---

Hanger or Support Spacing (unless specified different hereinafter):

Hanger or support maximum spacing shall be as follows:

Copper Pipe:

Nominal Pipe Size – Inches	Maximum Span - Feet
1-1/4" and under	6'
1-1/2" and above	10'

Cast Iron Pipe:

Length of Pipe – Feet	Maximum Span - Feet
5'- 0"	5'
10'- 0"	10'

Steel Pipe:

12'- 0" intervals

Size hangers on insulated piping to permit insulation and saddles to pass full size through hanger.

Trapeze Hangers:

May be used for groups of pipes close together and parallel. Trapeze hangers may be constructed from structural channel or angle irons or from pre-formed channel shapes. All pipe lines must be held on specific centers by U bolts, clips or clamps.

Inserts:

For each hanger on horizontal pipes, installed before concrete is poured. Inserts shall permit horizontal adjustment of the nut.

Special and Additional Supports:

Special supports will be required where hangers cannot be used. Horizontal pipes shall be secured to prevent vibration or excessive sway. Where pipes must be laid on fill, they shall be supported at each joint by brick or concrete supports carried down into solid, natural earth. Where required, provide additional hangers to secure required level, slope or drainage, and also to prevent sagging. Provide a hanger within one foot of each elbow. Provide all miscellaneous steel required for pipe supports, anchors, etc.

INSULATION SHIELDS:

Provide all insulated piping with 10-inch long (16 gauge) protective galvanized sheet metal shields extending 120 degrees around bottom of insulated pipe.

SWING CONNECTIONS:

Swing connections shall be provided at all points of expansion. Install all connections to equipment, etc. in a manner to allow for normal pipe movement due to thermal expansion without causing undue stresses to be exerted on said equipment.

REDUCING FITTINGS:

Where pipe lines reduce in size, provide reducing fittings wherever possible. Provide eccentric fittings or reducers where horizontal runs of supply lines reduce in size, and install so that there will be no air trapped in hot or cold water systems. In screwed work, no bushings shall be used unless there is a difference of two standard pipe sizes between inner and outer threads.

DIELECTRIC CONNECTIONS:

Wherever any connection is made between dissimilar metals, provide dielectric pipe couplings or unions.

UNDERGROUND BARE STEEL PIPE AND FITTINGS COVERING:

All underground bare steel pipe and fittings shall be wrapped mechanically with asphalt primer, and asphalt-saturated felt or asphalt-saturated glass wrapper bonded to the enamel all in accordance with Asphalt Institute Specification M1. Joints that cannot be factory coated shall be field coated by hand as above.

ELECTRIC WORK:

All motors, and motor starters shall be furnished for items installed under this division of the specifications. All starters shall be magnetic type. All electrically operated equipment shall have readily accessible nameplates summarizing electrical information (i.e., voltage, phase, horsepower, watts, or amperes). Starters shall be as manufactured by General Electric Company, Westinghouse Electric Company, Cutler-Hammer Inc., or Square D Company. A.C. magnetic starters shall be across-the-line type. Starters shall provide overload protection in each phase and shall otherwise conform to all applicable requirements of these specifications. All magnetic starters shall be combination type, Motor Circuit Protector (MCP) type having interrupting rating equal to or greater than the available short circuit current, with "HAND-OFF-AUTO" selector switch, auxiliary contact, and pilot light in cover. Provide laminated plastic nameplates with white center core for each starter.

All control conduit and wires and control devices shall be furnished and installed under this division. All contactors shall be of the mechanically held type. All control wiring within starters shall be installed in a workmanlike manner and neatly laced. All control wiring shall be color coded.

All work shall conform with the applicable requirements of the National Electrical Codes. All electrical power characteristics shall be as indicated. All devices, which make and/or break electrical circuits, shall be rated for at least 125 percent of the load.

Relays, contactors, and control devices shall open all ungrounded conductors. All fuses shall be current limiting time delay type equal to Bussman "LPN", 250 volt or "LPS", 600 volt.

Control voltage shall not exceed 120 volts. Control power shall be taken from line terminals of controllers. Where necessary, control transformers shall be provided and shall conform to NEMA Standards, properly sized, and shall be properly fused. Where control voltage is 120 volts, control conductors shall be color-coded.

Electrical power service and connections to all equipment in this division will be made under electrical division of the work.

Manual motor starters with overload protection shall be flush mounted type with pilot light. Square D Catalog No. 2510-FS-1P or General Electric, or Westinghouse equivalent.

Duct smoke detectors shall be provided under electrical division and installed under this division. This division shall provide interlock wiring required for fan shutdown and smoke damper control. Power wiring and fire alarm communication wiring shall be provided under the electrical division.

ITEMS OF MECHANICAL EQUIPMENT:

All items of mechanical equipment electrically operated shall be in complete accordance with paragraph in this division entitled "Electrical Work". Mechanical equipment, other than individually mounted motors, shall be factory pre-wired to a single-set of line terminals and to a single load terminal strip to match load terminals on equipment. Each step shall have properly sized contactor and overcurrent protection.

Mechanical equipment electrical components shall all be bonded together and connected to electrical system ground.

CLEANING:

All surfaces on metal, pipe, insulation covered surfaces, and other equipment furnished and installed under this division of the specifications shall be thoroughly cleaned of grease, scale, dirt and other foreign material.

Upon complete installation of ducts, clean entire system of rubbish, plaster, dirt, etc., before installing any outlets. After installation of outlets and connections to fans are made, blow out entire system with all control devices wide open.

SYSTEM BALANCING:

The HVAC Contractor is responsible for the entire Test & Balance process. The contractor shall employ an independent balancing firm specializing in total system air balancing as approved by the engineer and certified by the AABC or NEBB. The balancing firm shall be employed prior to installation of any ductwork. Provide all labor, engineering and test equipment required to test, adjust, and balance all heating, ventilating, air conditioning, hydronic and exhaust systems.

The Contractor is responsible to have a functioning system prior to Testing and Balancing, to provide a joint and cooperative effort to coordinate the test and balance, and to solve any problems in balancing and controls in order to establish proper system performance before leaving the job. The Contractor is responsible for providing the Test and Balance Agency (TAB) with a complete set of project drawings, specifications, and submittals, and for providing and installing new sheave or sheaves, new belts, as required, if a change in fan speed is necessary which cannot be made by adjusting the sheave originally installed. When requested by the Engineer, the TAB Agency will review plans and specifications of the systems prior to installation and submit a report of any deficiencies, which could preclude proper adjusting, balancing and testing of the system. The TAB agency shall submit copies of deficiency reports along with a preliminary report to the Engineer for review prior to final submittal.

Instruments used will be those that meet the instrument requirements for Agency Qualifications of the AABC as published in the NEBB "Procedural Standards for Testing Adjusting and Balancing of Environmental Systems" or the AABC "National Standards for Total System Balance".

Fan air volume shall be adjusted to within 5% of design, and diffuser air volumes to within 10% of design.

Water volumes shall be adjusted to within 10% of design whenever balancing cocks or flow meters are installed. Where automatic flow control valves are shown, pressure drop readings shall be taken across the coils to verify flow. After system balancing, the Mechanical Contractor shall trim pump impellor or adjust pump speed to maintain flow at design conditions. The pump flow shall not be restricted by valves to reduce flow volume.

Ductwork rated 4" w.g. and higher, all laboratory exhaust ducts, and ductwork indicated on the drawings shall be tested for leaks. All branch runouts and takeoffs shall be installed and capped before duct leakage testing is performed. Testing is not required for ductwork rated 0 to 3" w.g. Testing shall be done following the guidelines in SMACNA-HVAC Duct Leakage Test Manual. Duct test pressure shall be 1½ times scheduled external static pressure. Allowable leakage shall be 2% of total scheduled airflow.

Reporting (Submit five copies of final Test Report)

- Complete nameplate data and equipment schedule number for all rotating equipment.
- Design and actual operating data for all rotating equipment including inlet and outlet data, flow rates, amps, voltage and rpm.
- Design and actual duct and diffuser volumes. Prepare a diagram showing flow measurement points.
- Design and actual water flow rates. Prepare a diagram showing flow measurement points.
- Record coil air pressure drop, filter pressure drop, external static pressure, and fan static pressure.
- Record flow rates, temperatures and pressures across each water coil, condenser and other heat exchangers.
- Heating equipment nameplate data, equipment schedule number design data, and operating data at maximum achievable load conditions.
- Duct leakage test results.

TESTING (PIPING):

Upon completion of each system of work under this division, and at a designated time, all piping shall be pressure tested for leaks in the presence of the owner. Owner shall be notified five days before testing is to be conducted and all tests shall be conducted in the presence of the owner. All equipment required for test shall be furnished by contractor at his expense. All tests shall be performed as specified hereinafter. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated at no additional cost to owner. Make tight any leaks. Repeat tests until system is proven tight. Caulking of leaks will not be permitted. All equipment not capable of withstanding the test pressure shall be valved off during the test.

Hot and Cold Water Piping: Upon completion of rough-in and before setting fixtures, entire hot and cold water systems shall be tested at a hydrostatic pressure of 1-1/2 times operating pressure, but not less than 150 psig, and be proved tight at this pressure. Where a portion of water system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system. Water used for testing shall be from a potable source of supply.

Gas Piping: Gas piping shall be tested at not less than 1-1/2 times working pressure, and be proved tight at this pressure. (Minimum test pressure 100 psig.)

Chilled Water, Hot Water, Steam and Condenser Water Systems: Subject system to 1-1/2 times the working pressure, but not less than 100 psig hydrostatic test pressure. All water piping shall be balanced to produce water quantities as indicated with all automatic control valves wide open.

Steam and Condensate Systems: Upon completion of the installation, but before covering, all steam and condensate piping, and all heating equipment shall be given a hydrostatic test of 1-1/2 times the working pressure, but not less than 100 psig, and proven tight. Equipment not designed for this pressure shall be blanked off.

All refrigerant piping and apparatus shall be tested with dry carbon dioxide or nitrogen plus a small amount of refrigerant. All refrigerating equipment shall be tested under vacuum and shall show no evidence of leakage with an absolute pressure of .20 inch mercury gauge, sustained for a period of one hour without pumping. Leaks shall be corrected by remaking the joint. Test pressures shall be as follows:

High Side	Low Side
Refrigerant 410A - 400 psi	Refrigerant 410A - 350 psi

Install a card conspicuously and as near as practicable to the refrigerant condensing unit giving instructions for the operation of the system, including precautions to be observed in case of a breakdown or leak.

Each refrigerating system shall be provided with an easily legible metal sign permanently attached and easily accessible, indicating thereon the name and address of the manufacturer or installer, the kind and total number of pounds of refrigerant contained in the system and the field test pressure applied.

Systems containing more than 100 lbs. (45.4 kg) of refrigerant shall have all piping, valves, remote controls and pressure limiting devices tagged or color coded. Instructions as specified in 2802.1.1 shall clearly identify all such devices and their usage in the operation of the system.

IDENTIFICATION OF PIPING:

All piping, bare and insulated, installed under this division shall be given two coats of finish painting by this contractor as listed hereinafter. Paint shall be Glidden Industrial Enamel, or equal by Sherwin-Williams or Devoe Paints. Samples of colors and type paint shall be submitted for approval prior to application.

PIPE CODING:

After all piping has been painted with color-coding, all piping installed under this division shall be coded and marked with "Perma-Code" pipe markers as manufactured by W.H. Brady Company, 712 Glendale Avenue, Milwaukee, Wisconsin. Markers shall be applied to properly identify piping, but in no case shall they be applied more than 20 feet apart. Markers shall be 1-1/8 inch by 7 inches and shall be secured by spiral wrapping with 3/4 inch wide vinyl banding tape, color matching service, at each end of marker.

IDENTIFICATION OF EQUIPMENT IN MECHANICAL AREAS:

All items of mechanical equipment shall be identified with a black bakelite label with engraved white lettering 1/2" tall. Labels shall be mechanically attached to the equipment with rivets or stainless steel screws. Thermostats and control devices shall be identified with a black bakelite label with engraved white lettering 1/4" tall. Lettering shall correspond with the tags shown in the drawings.

ADJUSTMENT AND TRIAL RUNS:

Upon completion of all work, the contractor shall operate the system in the presence of the owner for the purpose of demonstrating quiet and satisfactory operation, the proper setting of controls, safety and relief valves, and cleanliness of system. Heating and cooling shall be tested separately during periods approaching design conditions and shall fully demonstrate fulfillment of capacity requirements. Test procedures shall be in accordance with applicable portions of ASME, ASHRAE, and other generally recognized test codes as far as field conditions will permit. Any changes or adjustment required shall be made by the contractor without additional expense to owner.

Document and submit all operating conditions (startup report) of equipment during trial runs and after test and balance is complete. Include in the report:

- Ambient air temperature
- Design operating temperatures and flow rates
- Entering and leaving air temperatures across each coil or heating device
- Entering and leaving water temperatures at each coil
- Entering and leaving water temperatures at each chiller, boiler or heat exchanger
- Amp draw of all motors and nameplate amps
- Voltage at each piece of equipment
- Refrigerant pressures and temperatures

OPERATION AND MAINTENANCE INSTRUCTIONS, AND MAINTENANCE MANUAL:

Upon completion of work, and at a time designated by the engineer, a competent employee of the contractor shall be provided to instruct a representative of the owner in the operation and maintenance of the system.

Minimum instruction period shall be:

- Air Conditioning System - 1 day

The Owner will video record the training sessions in part or in their entirety. Contractor shall participate and coordinate all parties and service personnel, including vendors, required to instruct Owner and facilitate video recorded training session.

Maintenance Manuals: The contractor shall compile and bind five (5) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. These instructions shall be delivered through the general contractor to the engineer for approval prior to final inspection.

Instructions shall include:

- Warranty letter signed by the Mechanical Contractor.
- Index for each section with each section properly identified.
- Complete equipment list with model and serial numbers.
- Complete equipment list with filter sizes and quantities.
- Copy of one complete, approved submittal for each equipment section.
- Description of each system, including manufacturer's literature for all items.
- Start-up and shut-down description for each system.
- Suggested operating and maintenance instructions with frequency of maintenance indicated.

- Parts list for all items of equipment.
- Name, address, and telephone number of nearest sales and service organization for all items of equipment.
- Startup reports.
- Test and Balance Reports

Manuals shall be 8-1/2 x 11 inch text pages bound in three ring expansion binders with a hard durable cover with clear plastic pocket on front for title page. Prepare binder covers with printed subject title of manual, title of project, date, and volume number when multiple binders are required. Printing shall be on face and spine. Provide a table of contents for each volume. Internally subdivide the binder contents with divider sheets with typed tab titles under reinforced plastic tabs. Provide directory listing as appropriate with names addresses, and telephone numbers of design consultant, Contractor, subcontractors, equipment suppliers, and nearest service representatives.

End of Section 230010

SECTION 230500 – HEATING, VENTILATION AND AIR CONDITIONING

PART 1 - GENERAL

General Requirements: This Section of the Specifications and related drawings describe requirements pertaining to Air Conditioning, Heating and Ventilation work, including applicable HVAC Insulation in separate Section 230700 and Vibration Isolation, Seismic Restraint in separate Section 230548 and Central Control and Monitoring System in separate Section 230900. All work shall comply with Section 230010 - General Provisions - HVAC.

Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 2005 Edition. All ductwork must comply with all local, state and federal code requirements.

PART 2 - PRODUCTS

SUBMITTALS:

Ductwork shop drawings must be submitted for approval by Engineer. Any ductwork installed without prior approval by the Engineer shall be replaced at the expense of the contractor.

QUALITY ASSURANCE:

The contractor must comply with this specification in its entirety. At the discretion of the Engineer, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

DUCTS, PLENUM, ETC.:

As indicated on drawings, provide a system of metal ducts for supply, return and exhaust air.

All sheet metal, ducts, casing, plenums, etc., of sizes indicated, shall be constructed from prime galvanized sheet steel.

DUCTS THRU WALLS:

Where ducts pass through masonry walls, protect duct from contact with wall by 1/2 inch thick filler of fire rated felt or sponge rubber.

Provide sheet metal flashing around all duct penetrations.

Ducts shall be properly sealed per the fire rating and UL assembly.

INSTRUMENT TEST HOLES:

Install for air handling units instrument test holes in supply, return and outside air duct. Instrument test connections shall be Ventlock Model 699-2, or equal, and shall be located in accessible locations.

AIR DISTRIBUTION:

Devices shall quietly and draftlessly deliver and/or remove air quantities required to attain conditions indicated. Devices shall have sponge rubber gaskets for sealing devices to walls and ceilings. Exposed surfaces shall have baked enamel finish of manufacturer's standard colors noted.

All air distribution equipment and accessories shall be as scheduled on drawings.

METAL DUCTWALL:

All interior ducts shall be constructed of G-60 or better galvanized steel (ASTM A653) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions shall be constructed of G-90 or better galvanized steel LFQ, chem treat. Galvanized metal ducts shall be a minimum thickness of 24 gage.

Dryer exhaust shall be aluminum alloy number 3003-H14 (ASTM B-209) and not less than 0.034" in thickness.

All ducts specified to be aluminum shall be alloy number 3003-H14 (ASTM B-209) and not less than 0.034" in thickness.

Support, access doors not part of ducts, bar or angle reinforcing damper rods and items made of uncoated mild steel shall be painted with two coats of primer or provide galvanized equivalent.

Medium Pressure Supply Duct:

Ductwork from the supply air fan to the terminal velocity reduction device (VAV box) shall be fabricated to meet minimum 4" w.g. pressure class in accordance with SMACNA Duct Construction Standard.

Low Pressure Supply, Return, and Exhaust Duct:

Ductwork downstream from the VAV box, ductwork on low pressure supply and return systems and restroom exhaust duct shall be fabricated to meet minimum 2" w.g. pressure class in accordance with SMACNA Duct Construction Standard.

LONGITUDINAL SEAMS:

Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

DUCT JOINTS:

Ductmate or W.D.C.I. proprietary duct connection systems will be accepted as an alternative to SMACNA duct construction standards. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.

ACCESS DOORS IN DUCTWORK:

Provide access doors at all apparatus requiring service and inspection, including fire dampers and fire smoke dampers, and where indicated. Access doors for 2" pressure class duct shall be hinged or Ductmate Sandwich Access Doors as manufactured by Ductmate Industries, Inc., or equal. Access doors for 4" pressure class duct shall be Ductmate Sandwich Access Doors as manufactured by Ductmate Industries, Inc., or equal. Access doors shall be double wall construction with high density fiberglass insulation with R value equal to or greater than the duct insulation. Doors shall be of adequate size (12" x 12" minimum) as required to allow easy access to hardware which needs to be maintained. In accordance with the requirements of the International Building Code, contractor shall permanently mark any access doors or other openings that serve as a means of access to fire dampers with ½" letters reading "Fire Damper". Label shall be permanently and securely attached.

FLEXIBLE DUCT:

Flexible duct to meet criteria as defined in SMACNA's 2005 Manual, HVAC Duct Construction Standards, Metal and Flexible, or as defined within.

Flexible duct is not allowed in lengths greater than 8', unless otherwise noted. Bends, turns, or sagging, is not accepted.

ROUND AND FLAT OVAL DUCTS:

Construction: In accordance with HVAC Duct Construction Standards, Section III.

Round and flat oval ductwork shall be Eastern Sheet Metal Oval Spiral Duct or approved equal spiral seam construction only. Gages shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted.

ROUND AND FLAT OVAL DUCT JOINTS:

Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening.

Joints 21"-72" diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.

Joints 73" diameter and up, use companion angle flanged joints only as defined on pages 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.

Flat Oval Ducts shall be joined with the Ovalmate Connection System manufactured by Ductmate Industries. Consult the manufacturer for installation and construction guidelines. As an option, beaded sleeve joints may be used.

SEALERS:

Duct sealer shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall seal out water, air, and moisture. Sealer shall be UL listed and conform to NFPA 90A & 90B. Sealer shall be Childers CP-145A, or equal.

DUCTWORK HANGER/SUPPORT:

Hang and support ductwork as defined by SMACNA, Chapter 5 2005 Manual, First Edition, or as defined within. Hanger spacing not to exceed 8'

TURNING VANES:

Turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA Standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturers instructions.

APPARATUS CONNECTIONS:

Flexible connections: For low velocity ductwork (less than 2,400 FPM), provide flexible connections at inlet and outlet of each fan connected to ductwork and elsewhere as indicated. Flexible connections shall be 6 inches wide, waterproof and fireproof, and shall be equal to "Hardcast Connector Plus Neoprene" flexible connectors. Provide at least one inch slack.

FIRE DAMPERS:

Provide at locations shown on plans, or in accordance with details, schedules or specifications Ruskin fire dampers of appropriate style, or approved equal. Provide fire dampers at all locations as required to comply with National Fire Protection Association Regulations, applicable city requirements, and all local codes or ordinances having jurisdiction. Construct fire dampers as follows:

Fire dampers shall be mounted in a U.L. approved integral sleeve or a No. 16 U.S. Gauge welded steel sleeve 12 inches long. Blades shall be hinged on brass trunnions and counter-weighted when necessary to assure closing. Blade thickness and other construction details shall conform to National Fire Protection Association requirements as set forth in NFPA Bulletin No 90A, and bear U.L. label. Dampers shall be held in open position by 165 degrees fusible link and arranged to lock in position on closure.

Fire dampers in medium pressure duct applications shall be provided with a fully welded, high free area and air tight transition.

Breakaway connections at fire damper sleeves with duct connections shall be made using UL approved "S and Drivemate Connections" or UL approved "Ductmate Breakaway Connections".

COMBINATION FIRE SMOKE DAMPERS:

Provide UL555S listed combination fire-smoke damper. Damper to be Ruskin Model FSD-36 Leakage Class II Combination Fire-Smoke Damper or approved equal. Frame shall be 5 inches by minimum 16 gauge galvanized steel hat channel, reinforced at corners. Damper blades shall be single skin 16 gauge with longitudinal grooves to strengthen blade. Flat blades are not acceptable. Bearings shall be self-lubricating stainless steel sleeve type. Provide silicone blade seals and/or metal jamb seals as required for leakage rating. Blade seals shall be mechanically attached. Glue-on seals not acceptable. Linkage shall be concealed in frame. Provide electric fuse link assembly. Provide 120v actuators, factory mounted and cycle tested. Actuators shall be 2-position, fail close. Provide factory sleeve in UL approved gauge. Sleeve shall be factory sealed to assure leakage rating. Minimum sleeve length to be 17" and shall be

long enough to allow for proper duct connection on both sides of wall/ceiling. Provide factory picture frame mounting angles in UL approved gauge. Breakaway connections are required on all fire and smoke damper installations unless the damper sleeve is at least 14 gauge galvanized steel. Install dampers, mounting angles, and breakaway connections per Manufacturer's UL installation instructions.

MANUAL OPPOSED BLADE DAMPERS:

Provide at locations shown on plans, or in accordance with details, schedules or specifications Ruskin Model CD35 manual opposed blade balancing dampers, or approved equal. Frame shall be 16 gage galvanized structural steel hat channel with tabbed corners for reinforcement. The blades shall be single skin, 16 gage galvanized steel with three longitudinal grooves for reinforcement. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream, within the damper frame to reduce pressure drop and noise. Submittal must include leakage, pressure drop, maximum velocity and maximum pressure data based on AMCA Publication 500.

PIPE AND FITTINGS:

Schedule of pipe and fittings: Piping and fittings shall conform to requirements as indicated herein.

SCHEDULE OF PIPING

SERVICE	ITEM	PIPING	FITTINGS	FLANGES OR UNIONS
Steam and Condensate	Steam mains 2-1/2" and larger	Black seamless or electric weld Sch. 40 ASTM A-106	Buttweld black steel Sch. 40	150 lb. forged black steel welding neck or slip-on flat face
	Steam mains 2" and smaller	Black seamless steel or electric weld Sch. 40 ASTM A-106	Screwed black malleable iron standard weight	Black malleable iron, RR unions brass to iron seat extra Heavy weight
	Condensate 2-1/2" & larger	Black seamless steel or electric weld, Sch. 80 ASTM A-106	Buttweld black steel Sch. 80	150 lb. forged black steel slip-on
	Condensate 2" and smaller	Black seamless steel or electric weld Sch. 80 ASTM A-106	Screwed black malleable iron extra heavy weight	Black malleable iron, RR unions brass to iron seat standard

				weight
Hot & Chilled Water	2" and smaller	Type L, Hard drawn copper copper	Solder type wrought to copper	Wrought solder copper
	2-1/2" and larger	Black steel Sch. 40 ASTM A-53	Buttweld black steel Sch. 40	150 lb. forged forged steel slip-on
Unitary Condensate Drain	2" and smaller	Type L, Hard drawn copper	Solder type wrought copper	Wrought solder copper to copper

VALVES LIST: All valves of similar type shall be of a single manufacture unless otherwise specified, and be of manufacturers highest grade.

All valves shall have malleable iron handwheels, valves 2-1/2 and larger cast iron handwheels, self locking stem nuts, and Teflon impregnated stem packing. Valves shall be asbestos free.

Steam and condensate valves up to 2" and larger inside building shall be Velan VEE-2000 stainless steel full port ball valves.

Steam and condensate valves 2" and larger in shall be Velan API600 cast steel class 300 gate valves.

Butterfly Valve (Use for Main Chilled Water Entry):

The valve shall be a 90-degree clockwise-to-close, nonrubbing, metal-to-metal-seated, zero-leakage bi-directional design. The valve shall be designed to require torque seating in order to achieve zero leakage. The valve shall be designed in accordance with ANSI B16.34, B31.1 and B31.3 standards. The body, disc and shaft must be designed within the allowable stress levels defined by ASME Sections III and VII for the material used. The pressure rating of the valve and the end connections shall be per ANSI B16.5. The face-to-face dimensions shall conform to API 609. The valve design shall be of all-metal construction, inherently firesafe and fire tested by a recognized independent agency. The valve shall be Series A1, API 609. Flanged valve bodies shall be one-piece cast or fabricated. The valve seat shall be integral with the valve body. A carbonsteel-bodied valve shall have a stainless steel welded overlay for the body seat. Plated carbon steel seating surfaces are not allowed. The valve seat, whether integral or welded overlay, shall be machined together with the valve. The valve seat shall be of a slanted conical shape with a 25-degree inclined angle for nonrubbing, frictionless, nonjamming, zero-leakage, bi-directional shut-off capabilities. The valve disc shall be of the same material as specified for the valve body. The disc shall be driven by the means of machined fitted keys. NO PINNING of the disc to the shaft is allowed. Shaft bushings shall be located as close to the centerline of the valve as possible to absolutely eliminate all possible shaft deflection or bending. Disc designs that use a single hub are not allowed. Valves designed with the end of the bushings located up into the valve body are not allowed. The seal ring shall consist of stainless steel lamination with a METALIC REINFORCEMENT to avoid washing out of the graphoil. The seal ring shall be machined in a parallel method to the laminates, and the outside diameter shall be machined to a conical 25-degree inclined plane. (Seal ring conical cone shall match the conical cone of the body seat.) NO ELLIPICAL SEAL RING SHALL BE ALLOWED. The seal ring shall be sealed to the disc and clamp ring by means of a flat graphoil gasket. NO SPIRAL-WOUND GASKETS ARE ALLOWED. The valve shaft shall be stainless steel. The shaft shall be a through shaft of one-piece construction. TWO-PIECE SHAFTS ARE NOT ALLOWED. No pinning of the shaft to the disc shall be allowed. Torque is delivered to the disc by means of machined keys. NO

AJUSTABLE THRUST BEARINGS ARE ALLOWED. The valve shaft shall be designed with an external method to prevent the shaft from blowout in the unlikely event that the internal connections between the shaft and disc are broken. This design must be in compliance with API 609 requirements. An adjustable packing gland shall be supplied. The packing shall consist of two braided graphite antiextrusion rings top and bottom and a minimum of two die-formed graphite rings in the middle. As a minimum, bearings shall be stainless steel with one ring of graphoil to act as a barrier for debris. For full bearing protection and zero emissions, a three-piece bearing set shall be supplied with three rings of graphoil rings on the interior and exterior of the three-piece bearing set. The three-piece bearing set shall be loaded by the load of the packing gland with a design to prevent any extrusion of the rings.

AUTOMATIC FLOW CONTROL VALVES:

Flow control valves shall be by Griswold Controls Isolator Y or equal, forged brass body with a stainless steel flow control cartridge assembly. The body design allows inspection or removal of cartridge without disturbing piping connections. Body has an integral handle ball valve, and a union end with interchangeable end pieces for the outlet of the valve body, and an integral 20 mesh stainless steel strainer element. The Isolator Y is provided with two pressure/temperature test valves with a hose bib adapter and cap.

COMBINATION STOP-BALANCING VALVES:

Ball Valves:

Sizes up to and including 2":

NIBCO 585 or equal ball valves, bronze body, threaded or soldered ends, 150 pound saturated steam and memory stop with "Nib-Seal" insulated handle.

Butterfly Valves:

Demco Inc. Series NE or equal lug type with corrosion resistant stainless steel stems, bronze discs, phenolic backup ring, and shall be suitable for temperature ranges - 10° to 275° F for 2-1/2" and larger. EPT seats shall be field replaceable.

Handles for valves 2-1/2" thru 6" shall be infinite throttling with memory stop. Valves 8" and larger shall be gear operated with hand crank and memory stop.

Circuit Setters:

Bell and Gossett Company Model CB or equal for sizes to eight inches. Up to three inches shall be of bronze and shall be constructed for a minimum of 200 psi at 250o F. Above three inches shall be of cast iron with flanged connections or ductile iron with grooved connections suitable for 175 psi working pressure. Each setter shall have meter connections for balancing. Model CB valves up to three inches shall be provided with a pre-formed polyurethane insulation unit.

STRAINERS:

Strainers shall be Sarco Company or equal, Y-pattern sediment separators, iron body, monel mesh screen. Sizes 2-1/2 inches and larger to be flanged pattern, Type CI-125; sizes 2 inches and smaller to be screwed pattern Type IT. Where basket type strainers are called for on drawings, they shall be Type Flanged - 125 cast iron large capacity.

TRAPS:

Provide traps for all locations indicated on drawings. Inverted bucket traps shall be Armstrong Series 800 or equal and F & T traps shall be Armstrong Series B or equal. Pressure rating of traps shall exceed that of line that it serves.

REFRIGERANT PIPING:

General: Execute all refrigerant piping with stamped type "ACR" hard copper and long radius, wrought copper, sweat fittings with tolerance not to exceed 3/1000 of an inch. All joints shall be made with silver solder. Submit equipment manufacturer's suggested piping diagram for approval.

Materials: Copper pipe and fittings shall be as manufactured by Mueller Brass Company or equal; expansion valves of proper capacity as manufactured by Sporlan or equal; strainers shall be V-type as manufactured by Sporlan or equal; catch-all replaceable core type drier as manufactured by Sporlan or equal; solenoid valve and sight glass as manufactured by Sporlan or equal.

After refrigerant piping has been installed and tested, each system shall be evacuated and charged with proper refrigerant of quantity as recommended by manufacturer.

CONVERTERS, EXPANSION TANKS, AIR VENTS AND AIR REMOVAL EQUIPMENT:

Converters, expansion tanks, air vents and air removal equipment shall be of the characteristics and capacities indicated on drawings and as manufactured by Bell and Gossett Company or equal, and ASME stamped. Install manual air vents at all high points where indicated and where required to properly and adequately vent systems. All above equipment shall be manufactured by one manufacturer, and completed systems shall be installed in accordance with manufacturer's instructions. Certificates shall be furnished to Engineer for all ASME stamped equipment and for performance guarantee of air removal system to prevent air accumulation and air noise in system.

PRESSURE REDUCING STATION:

Provide a factory assembled single or dual stage steam pressure reducing station of the capacities and characteristics indicated. Pre-Engineered, Pre-Packaged Steam Pressure Reducing Station shall be complete with Pilot Operated Pressure Reducing Steam Valves, Spring Pilots, Pressure Relief Valves, Drip Pans, Bypass Globe Valves, Isolation Valves, and Drip Trap Assemblies, pre-piped, and mounted on and supported by a frame of Welded Structural Steel Members. When installed, entire PRV station shall stand on floor or be supported by wall brackets supplied with station.

Each packaged unit shall be factory assembled and provided with the components required to meet the requirements of this specification. The piping system and in-line appurtenances shall be subjected to a pressure test after final assembly. Test pressure shall be not less than 10% below the setting of the packaged system's relief valve(s). The duration of the test shall be two hours. No change in the test pressure over the two-hour test period is allowed. Loss of pressure requires the leak shall be fixed and the packaged system shall be retested.

Structural Steel Frame:

The frame shall be heavy-duty steel channel and angle iron construction. The frame material shall be ASTM A36 structural steel. All welding for the frame shall be performed by ASME Section IX certified welders.

Valves:

All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

Gate Valves:

For steam pressures less than 100 psig:

2" and smaller valves shall be threaded Class 125 rising stem, union bonnet, solid wedge and manufactured in accordance with MSS-SP80. Body, bonnet and wedge are shall be of bronze ASTM B62. Stems shall be of dezincification-resistant silicon bronze ASTM B371 or low-zinc alloy B99, non-asbestos packing and malleable iron handwheel.

2 ½ inch and larger valves shall be flanged Class 125 manufactured in accordance with MSS-SP70, flanged, bolted bonnet, OS&Y, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron. Packing and gaskets shall be non-asbestos.

For steam pressures between 100psig and 150 psig

2" and smaller valves shall be threaded Class 150 rising stem, union bonnet, solid wedge and manufactured in accordance with MSS-SP80. Body, bonnet and wedge are shall be of bronze ASTM B62. Stems shall be of dezincification-resistant silicon bronze ASTM B371 or low-zinc alloy B99, non-asbestos packing and malleable iron handwheel.

2 ½ inch and larger valves shall be flanged Class 250 manufactured in accordance with MSS-SP70, flanged, bolted bonnet, OS&Y, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron. Packing and gaskets shall be non-asbestos.

Globe Valves, for Throttling:

For steam pressures below 100 psig

2 inch and smaller valves shall be threaded Class 200 and manufactured in accordance with MSS-SP80; body and bonnet are to be of bronze ASTM B62. Full plug seat and disc shall be stainless steel. Valve stems shall be of copper-silicon alloy. Valve shall have Teflon impregnated packing, and valve shall have full plug stainless steel seat and disc. Valves shall have a malleable iron handwheel.

2 ½ inch and larger valves to be flanged Class 125 manufactured in accordance with MSS-SP85, with bolted bonnet, OS&Y, ASTM A126, cast iron body. Seat, and disc shall be ASTM B584 Cast Bronze. Body and bonnet shall be ASTM A126 Class B cast iron. Packing shall be graphite impregnated and gaskets shall be synthetic fibers. Valves shall have a cast iron handwheel.

For steam pressures between 100 and 150 psig

2 inch and smaller valves shall be threaded Class 200 and manufactured in accordance with MSS-SP80; body and bonnet are to be of bronze ASTM B62. Full plug seat and disc shall be stainless steel. Valve stems shall be of copper-silicon alloy. Valve shall have Teflon impregnated packing, and valve shall have full plug stainless steel seat and disc. Valves shall have a malleable iron handwheel.

2 ½ inch and larger valves to be flanged Class 250 manufactured in accordance with MSS-SP85, with bolted bonnet, OS&Y, ASTM A126, cast iron body. Seat, and disc shall be ASTM B584 Cast Bronze. Body and bonnet shall be ASTM A126 Class B cast iron. Packing shall be Teflon impregnated and gaskets shall be reinforced graphite. Valves shall have a cast iron handwheel.

Painting:

Each factory assembled packaged system, including all major components, shall be thoroughly cleaned after fabrication is complete. Entire package shall be primed after cleaning. After cleaning and priming, the package shall be painted with at least one coat of high-quality machinery grade enamel paint.
Nameplates of the components shall not be painted over.

Major Steam Specialties

Main Valve:

Furnish ITT Hoffman Specialty 2000 Series Main Valve(s) of the size, type and quantity specified and in the Packaged Steam Pressure Reducing Station schedule on the drawings. Steam pressure reducing valve shall be self-operated, external pilot type, single seated, normally closed diaphragm actuated. The main valves shall have stainless steel trim, and the diaphragm shall be constructed of two-ply stainless steel. Main valve bodies shall be cast iron. Bodies 2" and smaller to have screwed ends, 2-1/2" and larger shall have flanged ends. Valve shall regulate an accurate delivery pressure within plus or minus one pound per square inch (1 psig) throughout the range of pressure and flow conditions scheduled regardless of deviation of the inlet pressure. Regulators shall respond quickly and accurately without pressure deviation when installed on a single stage or two stage reduction. Valve shall function quietly and shut tight on a dead end (no flow) condition. Main valve(s) shall meet ANSI Class VI for maximum allowable seat leakage in accordance with standard, ANSI/FCI 70-2-1991. The main valve spring shall be installed in the general area of the diaphragm and pressure plate to minimize stem guiding surface and to keep the spring out of the path of the steam. Stuffing boxes will not be permitted. All parts must be accessible without removal of valve from the piping. The main valve seat and plug shall be completely replaceable.
The main valve control stem shall be internally guided and pressure shall be positively communicated between the outlet and the upper diaphragm chamber. Travel of the main valve seat shall be controlled by internal positive stops and shall be automatically set by the control stem. Each valve shall be provided with a permanently engraved nameplate bearing the name of the manufacturer, model number, valve size, and installed seat size.

Spring Pilot:

Furnish an ITT Hoffman SPS Series spring pilot of the appropriate spring range for each main valve. Pilots shall be designed shall be interchangeable with all sizes of main valves. The pilot shall be capable of being mounted on the main valve body via nipples and a union. The pilot shall have a hardened-corrosion resistant stainless steel seat. A strainer screen shall be built into the pilot inlet. The pilot diaphragm shall be 2-ply construction. Bleed ports and other orifice fittings shall be externally connected to facilitate troubleshooting and cleaning. Internal bleed ports will NOT be acceptable. The pilot shall be capable of being repairable without removing from the system. Each valve shall be provided with a permanently engraved nameplate bearing the name of the manufacturer, model number, and spring range.

Gauges/Siphon/Needle Valve:

Furnish a bottom connected 4-1/2" liquid filled gauge mounted on a ¼" NPT steam siphon with a brass needle valve below the gauge to dampen pressure fluctuations and facilitate removal of the gauge. Gauge pressure range shall exceed set pressure rating by 50 percent minimum.

Condensate Trap Assembly(S):

Furnish steam trap assemblies with ITT Hoffman Specialty Steam Traps of the size type and quantity specified in the Packaged Steam Pressure Reducing Station schedule on the drawings. Float and Thermostatic Traps: ASTM A 278, Class 30 cast iron body and bolted cover rated at a minimum of 175 psig. Traps shall have renewable, stainless steel float mechanism, with renewable, hardened stainless steel head and seat; and a balanced pressure thermostatic air vent made of stainless steel or monel bellows with a stainless steel head and seat. Inverted Bucket Traps: ASTM A 278, Class 30 cast iron body and cover, pressure rated for 250 psi; stainless steel head and seat; stainless steel valve retainer, lever, guide pin assembly, and a stainless steel bucket. Traps shall also have an Integral stainless steel inlet strainer within trap body. The trap seat pressure rating must be equal to or greater than the steam supply to the equipment. A Y-type steam strainer shall be installed in the piping ahead of the trap. Isolation valves and unions shall be installed at the trap inlet and outlet piping to facilitate removal of the trap.

Safety Valves:

Furnish Kunkle Steam Safety Valve(s) of the size type and quantity specified in the Packaged Steam Pressure Reducing Station schedule on the drawings. Cast-Iron Safety Valves: cast iron body and bronze seat, Class 250; forged copper alloy disc and nozzle; fully enclosed stainless steel spring having an adjustable pressure range and positive shut-off; threaded end connections for valves 2 inch and smaller, raised face flanged inlet and threaded outlet connections for valves 2-1/2 inch and larger. Furnish safety valves complete with cast iron drip-pan elbow having threaded or flanged inlet connection sized for full size of safety valve outlet and threaded drain outlet. Valves shall be selected for full relief of capacity of main valve served, in accordance with ASME Boiler and Pressure Vessel Code. Valves shall be factory set to relieve at 10 psi below the lowest rated operating pressure of downstream equipment served.

Steam Strainers:

Furnish Keckley Steam Strainers as required for the Packaged Steam Pressure Reducing Station. Line size steam strainers shall be installed upstream of each main valve and each steam trap. Y-Pattern Strainers shall be rated minimum 250 psig steam working pressure; cast iron body conforming to ASTM A 278, Class 30. Strainers shall have threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger. Strainers shall have 18-8 stainless steel screen (20 mesh for 2 inch and smaller, and manufacturer recommended perforations for sizes 2-1/2 inch and larger); tapped blow-off with nipple, valve and plug.

VENTILATING FANS:

See Schedule for characteristics and accessories. Units shall be AMCA or PFMA certified. Use shaded pole, single phase motors under 1/4 HP and split capacitor or polyphase motors 1/4 HP and larger.

Fans shall be complete with all accessories required for installation including integral overload protection or motor starter.

THERMOMETERS FOR DUCTWORK:

Provide in the discharge in the return air and outside air of all air handling units, a Marshalltown Figure No. 112 bimetal indicating dial range 0-140 degrees F thermometer. All thermometers shall be placed in a location so as to be easily and conveniently read.

FILTER RESISTANCE INDICATORS:

Provide filter resistance indicators for each air handling unit on external of filter section and in an accessible location. Filter Resistance Indicator shall be as manufactured by F.W. Dwyer Manufacturing Company, Series 2000.

AIR HANDLING UNIT:

Provide McQuay Modular Climate Changers or approved equal (see Section 230010) of the type, arrangement, size, and indicated capacities and characteristics. Air handling units shall be cETLus safety listed that conforms to UL Standard 1995. Air handler furnished with double width, double inlet (DWDI) shall be certified in accordance with the central station air handling units certification program, which is based on ARI 430. Air handling unit water heating & cooling coils shall be certified in accordance with the forced circulation air cooling and air heating coils certification program, which is based on ARI Standard 410.

Fabricate unit with 16 gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

Panels and access doors shall be constructed as a 2-inch (50-mm) nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-13. The outer panel shall be constructed of G90 galvanized [G60 painted galvanized] [18-gauge] steel. The inner liner shall be constructed of G90 galvanized [solid stainless] steel. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum positive or negative 8inches of static pressure. Deflection shall be measured at the midpoint of the panel height. The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 6 inches of negative static pressure or 5 inches of positive static pressure. Module to module assembly shall be accomplished with an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards. Entire unit shall have a 6 -inch full perimeter base rail for structural rigidity and condensate trapping.

Access Doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size (4.5" minimum) handle assembly (provide inspection window for fan section). Door shall swing outward for unit sections under negative pressure (inward for unit sections under positive pressure). Doors limited from swinging inward (such as side access filter sections) on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section [fan section]. Drain connection centerline shall be a minimum of 3" above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2" thickness of insulation under drain pan.

Fan Section:

Provide DWDI airfoil supply fan. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry

Bearings shall be self-aligning, grease lubricated, ball or roller bearings with extended copper lubrication lines to access side of unit. Grease fittings shall be attached to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Basic load rating computed in accordance with AFBMA - ANSI Standards, [L-50 life at 200,000 hours – all DWDI fans] heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor shall be 1.5 S.F.

Electrical:

The air handler(s) shall be ETL listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70. Fan motors shall be 1800 rpm, ODP. Motors shall be high efficiency to meet EPAct requirements and rated for inverter duty. Air handler manufacturer shall provide and mount conduit and wiring from each fan motor terminated external to unit. Provide factory mounted and wired ABB ACH-550 variable speed drive with electrical characteristics as shown on project schedule. A two-contactor type bypass switch shall be provided with a circuit breaker disconnect.

Cooling and Heating Coil Sections:

Provide access to coils from one side of unit for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

Water Coils:

Certification - Acceptable water coils are to be certified in accordance with ARI Standard 410 and bear the ARI label. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with ARI Standard 410. Manufacturer must be ISO 9002 certified. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements. Fins shall have a minimum thickness of 0.0075" of aluminum construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins. Coil tubes shall be 5/8 inch (16mm) OD seamless copper, 0.025" nominal tube wall thickness, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of .025". Coil connections shall be [N.P.T. threaded carbon steel] with connection size to be determined by manufacturer based upon the most efficient

coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up. Coil casings shall be a formed channel frame of galvanized steel. Water heating coils, 1 & 2 row only (sans 5M type) shall be furnished as uncased to allow for thermal movement and slide into a pitched track for fluid drainage.

Filters:

Provide 2" pleated MERV 13 filters in angular rack. Manufacturer shall supply minihelic gauge to read pressure drop across the filter bank for scheduling filter replacement. Design shall be equal to a Dwyer Minihelic 2 and be recessed into the cabinet to minimize chances for damage during shipment and installation. Installing contractor to provide 2 sets of spare filters to owner.

Mixing box section shall be provided with factory mounted low leak airfoil blade outside and return air dampers of galvanized steel in a galvanized frame. Dampers shall be hollow core airfoil blades, fully gasketed and have continuous vinyl seals between damper blades. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow.

Access section shall be provided after each coil and shall include access door. Access section between chilled water coil and hot water coil shall include a stainless drain pan.

FAN COIL UNITS:

Provide Enviro-Tec Model HLE Fan Coil Units or approved equal (see Section 230010) of the type, arrangement, size, and indicated capacities and characteristics. Units shall be completely factory assembled, tested and shipped as one piece. All units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery. All unit dimensions for each model and size shall be considered maximums. Units shall be ETL listed in compliance with UL/ANSI Standard 1995, and be certified as complying with the latest edition of ARI Standard 440.

Construction:

Unit chassis shall be fabricated of heavy gauge galvanized steel panels able to meet 125 hour salt spray test per ASTM B-117. Casing shall be internally lined with Elastomeric Closed Cell Foam Insulation. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.

Unit mounting shall be by hanger brackets provided at four locations. Hanger brackets shall include rubber grommet isolators with brass eyelets for threaded rod.

Cabinet:

To accommodate piping packages, cabinet is to have special 10" extended end pocket in addition to the standard piping space provided. Cabinet shall be finished with a heat cured anodic acrylic powder paint of the standard factory color. Paint shall exceed 500 hour salt spray test. Color shall be Enviro-Tec Pearl White. Cabinet shall have integral stamped return. Cabinet shall have double deflection supply grille option. The bottom of cabinet shall hinge open for access and service.

Sound:

Units shall have published sound power level data tested in accordance with ARI Standard 350-2000 (non-ducted equipment) and ARI Standard 260-2001 (ducted equipment).

Fan Assembly:

Unit fan shall be a dynamically balanced, forwardly curved, DWDI centrifugal type constructed of 18 gauge zinc coated galvanized steel for corrosion resistance. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL and CSA listed automatic reset thermal overload protection and three separate horsepower taps. Single speed motors are not acceptable.

The fan assembly shall be easily removable for servicing the motor and blower at, or away from the unit. The entire fan assembly shall be able to come out of the unit by removing two screws and unplugging the motor. Plenum unit fan assemblies shall be easily serviced through an access panel provided.

Devices used to energize and de-energize (switch) fan speeds must be totally silent. Magnetic, mercury, and/or quiet relays and/or contactors are not acceptable.

Coils:

All cooling and heating coils shall optimize rows and fins per inch to meet the specified capacity. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin. Copper tube wall shall be minimum of 0.025. **Tube walls with thickness less than 0.025 shall not be acceptable.** Fins shall have high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.

All coils shall be hydrostatically tested at 450 PSIG air pressure under water, and rated for a maximum of 300 PSIG working pressure at 200°F.

Cooling Coil casing shall be fabricated from 304 Stainless Steel.

All coils shall be provided with a manual air vent fitting to allow for coil venting.

Heating coils shall be furnished in the reheat position.

Drain Pans:

Provide a single wall primary drain pan constructed entirely of heavy gauge stainless steel for superior corrosion resistance. Drain pans shall be of one-piece construction and be positively sloped for condensate removal. Drain pans on concealed models shall be field reversible for right or left hand connections.

The drain pan shall be externally insulated with a fire retardant, closed cell foam insulation. The insulation shall carry no more than a 25/50 Flame Spread and Smoke Developed Rating per ASTM E-84 and UL 723 and an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21.

Drain pan shall be provided with factory mounted and wired overflow switch

Provide an oversized auxiliary drip tray under chilled water valve package. Auxiliary drip tray shall be constructed of stainless steel and insulated with closed cell insulation. This tray shall fasten directly to main drain pan. Drip tray to be field installed by contractor.

Filters:

All plenum and exposed units shall be furnished with a minimum 1" pleated filter (MERV 8). Filters shall be tight fitting to prevent air bypass. Filters shall be easily removable from the bottom of the unit. Contractor to furnish 2 spare sets of filters to owner.

Electrical:

Units shall be furnished with single point power connection. Provide an electrical junction box with terminal strip for motor and other electrical terminations. The factory mounted terminal wiring strip shall be an integral part of the ETI BC-06 Control board with integral control transformer and 3-speed relays. Provide toggle disconnect switch.

Provide a hinged electrical enclosure in the bottom of the unit for easy access to all electrical components, terminal blocks, BC06 control board and wiring. JCI FEC DDC Controller shall also be factory installed and wired in this enclosure.

Piping Packages:

Provide factory piping package components for all fan coil units. Piping packages shall consist of following:

Chilled Water Supply: strainer with blowdown valve, P/T's, shutoff valve, union connection
Chilled Water Return: union connection, PIC control valve (provided by JCI), P/T's, shutoff valve
Hot Water Supply: strainer with blowdown valve, P/T's, shutoff valve, union connection
Hot Water Return: union connection, control valve (provided by JCI), flow control/shutoff valve, P/T's

Components shall be provided to contractor for field installation. Components shall be installed so that the chilled water packages sit over auxiliary drip pan. Any additional fittings that may be required such as elbow fittings shall be the responsibility of the installing contractor. Due to the weight of the piping packages, some additional support/bracing will be required by the installing contractor. This support can be provided either through wire hanger atttached from top of unit cabinet to piping package or through metal bracing off rear cabinet panel. Plastic tie straps are not acceptable. Contractor shall install in a manner that allows for removal of piping package should service be required.

Controls Package:

FCU Manufacturer to provide, install and wire any and all controls required to accomplish the FCU sequence of operation specified per the following table:

Control Device	**Supplied By**	**Installed By**	**Wired By**
DDC Controller	Controls Contractor	FCU Manufacturer	FCU Manufacturer
Space Sensor	Controls Contractor	Controls Contractor	Controls Contractor
FCU Speed Switch	Controls Contractor	Controls Contractor	Controls Contractor
Control Valves	Controls Contractor	Mechanical Contractor	Controls Contractor
Discharge Air Sensor	Controls Contractor	Controls Contractor	Controls Contractor
Control Transformer	FCU Manufacturer	FCU Manufacturer	FCU Manufacturer

Fan Speed Relay Control	FCU Manufacturer	FCU Manufacturer	FCU Manufacturer
Drain Pan Float Switch	FCU Manufacturer	FCU Manufacturer	FCU Manufacturer
Controller Enclosure	FCU Manufacturer	FCU Manufacturer	Not Applicable

Notes:
1) Installation shall include mounting, wiring and terminations.
2) FCU shall be made completely ready for field termination of space sensor, speed switch and control valves and discharge air sensor
3) Control devices specified to be provided by controls contractor but installed by manufacturer shall shipped direct to manufacturer for factory installation
4) FCU controller shall be field programmed by controls contractor.
5) Manufacturer to wire DDC controller per wiring diagram provided by controls contractor.

ENERGY RECOVERY AIR HANDLING UNIT:

Provide Munters Energy Recovery Air Handling Unit or approved equal (see Section 230010) of the type, arrangement, size, and indicated capacities and characteristics.

Wiring internal to the unit shall be wired to a numbered terminal strip for simplified identification and ease of trouble shooting. Units shall be ETL listed and labeled, classified in accordance with UL 1995/CAN/CSA/ No. 236-M90.

Standard catalog units requiring modification to meet these specifications or units that are field assembled from pre-fabricated panels shall not be considered or accepted. The manufacturer must also have a net worth greater than five times the value of the equipment being bid and must have been a manufacturer of packaged energy recovery equipment for at least ten years prior to bid time. The complete packaged unit, including air-to-air heat exchangers, must be manufactured in the United States of America.

Warranty:

The Contractor shall provide a written warranty, signed by the manufacturer, agreeing to replace/repair, within warranty period, components with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation. Warranty Period shall be 1 year and provided by the Unit Manufacturer.

Structural Support:

Unit shall include self supporting factory installed base rail and any additional factory installed support to allow for mounting on the base rails shown on the plan. Unit ends will be cantilevered off end of base rails on both sides.

Casing:

Base Frame: The base of the package shall be an all-welded structural "C" channel steel frame with required tubular and angular cross-members as required to maintain floor rigidity and stiffness & act as isolator supports – all solid welded in place. The base shall be painted with one coat of a lead-free, rust-inhibiting, alkyd metal primer, followed by two coats corrosion and weather resistant 100% acrylic latex paint. Units up to 300" long shall include no more than four lifting lugs. Lugs shall be an integral part of the structural frame and shall be all welded using three-pass

welds. Frame shall be constructed to limit deflection to 1/200th of its span in any direction. Bolted or screwed base frame and floor assemblies are not acceptable due to their poor structural integrity and propensity to leak.

Unit Bottom: Unit shall be designed to sit on structural equipment rails. Bottom of unit shall be insulated, skinned with galvanized metal and weatherproofed.

Cabinet: Unit casing shall be of the monocoque stressed skin design with 2-inch double-wall, watertight construction. Walls and roof shall have an 18-gauge outer skin (see Casing Exterior Finish options below) with a 22-gauge galvanized steel inner liner. 2-inch minimum, 1.5 pound density fiberglass insulation shall be secured between the inner and outer skins. The insulation shall be held between the inner and outer walls and shall not be exposed to any air streams. All roof and sidewall seams shall be positively sealed to prevent water and air leakage. All roof joints shall incorporate a flanged and capped standing seam to insure a watertight seal. Outdoor units over eight feet wide shall have a pitched roof to eliminate standing water on the unit. Air leakage shall not exceed 1% at 1-1/2 times maximum unit operating pressure. All fastening hardware between wall panels shall be encapsulated within the wall for a clean exterior appearance and to minimize exterior wall panel penetration. Unit shall be constructed to limit panel deflection to 1/200th of its span in any direction.

Access Doors: Self-supporting hinged access doors shall be provided for all internal components requiring periodic maintenance or inspection. Weather-resistant closed-cell neoprene bulb type gaskets shall be a mechanically fastened to the frame to create a smooth continuous seal, with long radius corners, around the entire perimeter of the door with only a single splice point. The advantage of single piece long radius gasket material is to prevent sharp corners and multiple splice points. The door shall be insulated the same as the unit casing, and double-wall constructed with full-length stainless steel piano-type hinges for rigidity and airtight enclosure. A minimum of two adjustable glass reinforced nylon handle-type door latches shall be furnished for each hinged door. Door handles shall be provided with large nylon tapered roller cam for ease of operation and superior gasket depression. Each hinged door shall include locking mechanism that requires the use of a tool to open for safety and security purposes prior to unit startup. Handles shall be operable from either side of the door. Doorframes shall be a minimum 16 gauge aluminized or 304L stainless steel, welded at the corners to create a continuous rigid sealing surface for the door. Doors shall have adhesive-backed stickers applied to their exterior surfaces which indicate the unit contents that lie behind that door. All exterior doors shall be equipped with rain gutters. Doors shall be manufactured in such a way as to allow removal of interior components without disassembly of the wall panels. Access panels that are not hinged shall only be allowed for coil or heat exchanger removal. Hinged doors shall include door tie-backs.

Floors: Floors shall be constructed of seam welded 16ga aluminized steel. Floors shall be insulated with a minimum of 1-inch closed cell foam insulation installed beneath. Insulation shall cover entire floor of unit, leaving no exposed metal for condensation to occur. Floors shall have an upturned flange around the entire perimeter and around all interior chases to contain moisture within the unit. The entire floor and upturn flanges must be factory water tested and certified leak proof for a period of five years from the date of shipment. Multiple floor drains shall be provided to route moisture to exterior accessible side or bottom 1-1/2 inch NPT drain connections (see the Drawings for drain locations). Drains shall be flush with the unit floor so as not to create a trip hazard. Floor interface with the drain tube shall be circumferentially fillet welded to prevent water leakage under the unit floor. The use of sealants for this purpose shall not be acceptable. All drains and associated piping are to be fully welded and tested

Casing Finish: Exterior G90 galvanized wall panels shall be pressure wash cleaned and degreased prior to application of primer. BASF paint system shall include 0.20 average mil primer and 0.75 average mil textured finish top-coat. Wall panels shall be positively coated, including all seating surfaces and the inside surface facing wall insulation (painted before assembly). Paint system shall comply with ASTM B117 2000-hour salt fog resistance test.

Hoods: For outdoor units, intake and exhaust hoods shall be provided. Opening shall be covered with an aluminum bird screen which is separate from the hood. The intake hood shall have a maximum 500 feet per minute face velocity through the free area. Hood material shall match that of the outer casing, and may be shipped loose for field installation and/or assembly by the Contractor.

Enthalpy Wheel Heat Exchanger:

Wheel Matrix: The rotary air-to-air heat exchanger shall be manufactured by the unit manufacturer. Manufacturers that require third party heat exchangers shall be considered unacceptable for lack of experience. Rotor shall be constructed of rotating honeycomb matrix consisting of a highly selective desiccant, permanently bonded to aluminum. The desiccant material shall be a molecular sieve with pore diameter of 3A to minimize the carryover of undesirable gases. The corrugated media provides individual flutes to channel the airflow and the thus minimize cross contamination and ensure rated performance under all differential pressure conditions. The desiccant coating shall provide corrosion resistance against attack from office, laboratory, hospital, pharmaceutical chemicals, etc., and protection in coastal and marine environments.

Wheel Casing: The wheel frames shall consist of evenly spaced galvanized steel spokes, galvanized steel outer band, and a rigid center hub. The wheel construction shall allow for wheel alignment. The wheel seals shall be brush type and shall be easily adjustable. Brush seals shall be included to separate fresh air from exhaust air across entire surface of air entering side, air leaving side and outer band (all four planes). Additionally, the entire circumference of the rotor shall include brush seal to minimize air bypass. Cassettes shall be fabricated of heavy-duty, reinforced 16-gauge galvanized steel. Bearings shall be outboard-flanged ball bearing with concentric locking collars. Bearings shall be permanently sealed and lubricated for zero maintenance and long life. Drive system shall consist of a heavy-duty AC motor driving a self-adjusting, easily replaceable multi-link belt. Heat exchangers shall be tested in accordance with ASHRAE Standard 84-1991 and ARI Standard 1060.

Energy wheel must be arranged within the heat recovery system so as to minimize differential pressure while keeping the exhaust side negative in comparison to fresh air side. See drawings for required fan arrangement.

Wheel Accessories:
Rotation detector

Heat Pipe Heat Exchanger:

The heat pipe heat exchanger shall be manufactured by the unit manufacturer. Manufacturers that require third party heat exchangers shall be considered unacceptable for lack of experience. Heat exchanger shall be constructed of one-piece extruded aluminum tubes installed within a 16-gauge galvanized steel casing providing both structural integrity as well as an airtight seal. Individual heat pipes shall be furnished within the casing and will accommodate expansion unique to each tube without damage to the integrity of the entire heat exchanger. The heat pipes shall be individually charged 1-inch I.D. with 0.063-inch wall thickness. Fins shall be of 0.015 mean thickness, tapered root to fin tip. Fin surface from root to fin tip shall have aluminum of 0.437 inch mean fin height. Fin density shall be 11 fins per inch. Heat pipes shall be a maximum of 2-1/8 inch on center in the face, and shall be 1-7/8 inch on center row-to-row. Two component heat pipes such as expanded tube-to-fin shall not be acceptable in order to prevent efficiency degradation resulting from the eventual weakening of the fin-to-tube bond with age.

Heat pipes shall be individually processed, weld-sealed, charged, and factory tested. Each pipe is constructed with an automotive type valve, which provides the opportunity to take advantage of future refrigerant developments. Heat transfer fluid shall be Class I in the American National Safety Code for mechanical refrigeration. Heat exchanger performance shall be rated in accordance with ASHRAE Standard 84-1991 and ARI Standard 1060.

Supply and Exhaust Fans:

The supply and exhaust airs fan shall be airfoil DWDI type, class 2 minimum.

Flexible duct connections shall be provided to isolate the fan from the cabinet housing as required. Bearing supports shall be constructed of structural steel members to prevent vibration and to rigidly support the fan shaft and bearings. Bearings shall be heavy-duty grease lubricated, self-aligning ball or roller pillow block type. Bearings shall be selected for a basic rating fatigue life (L-50) per AFBMA Standards of 200,000 hours at maximum operating speed for each pressure class and shall be rigidly mounted on welded structural steel members to prevent vibration. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

Fan performance shall be based on tests and procedures performed in accordance with AMCA Publication 211 and Publication 311.

Fan Accessories:
Lubrication lines shall be extended to a common point on the fan chassis inside the nearest access door.
Belt guards to protect personnel from moving drive parts

Motors and Drives:

Fan, motor and belt drive shall all be mounted on a spring-isolated chassis (minimum isolation efficiency of 90 - 95%). Belt drive shall have a minimum service factor of 1.5.

Motor electrical connections are to be factory prewired to the unit control panel. Motor shall be mounted on adjustable base. Open Drip Proof (ODP) (supply air and exhaust air fans) type fan motors shall be furnished with efficiencies equal to or greater than those specified in the Energy Policy Act of 1992 (EPACT).

Motor starters: Provide variable frequency drive with bypass and circuit breaker mounted in the unit return air plenum for both fans. VFD display is to be mounted in the unit electrical panel. VFD shall be ABB Model ACH550 or equal and shall be Bacnet capable. Provide factory start-up service and 2-year parts and repair labor warranty for VFD's. VFD's shall be programmed for soft-start with miminum ramp time of 15 seconds.

Dampers:

All dampers shall be of the low leakage airfoil blade type with blade edge and side seals. Dampers shall be constructed of extruded aluminum frames (6063T5) of not less than 2.03 mm thickness. Blades shall be of extruded aluminum profiles with blade gaskets of extruded EPDM. Frame seals shall be of extruded TPE. Gaskets shall be secured in an integral slot within aluminum extrusions.

The following dampers shall be provided:
Outdoor air damper with electric 2-position actuator and end switch
Exhaust air damper with electric 2-position actuator and end switch

Chilled Water Coil:

Chilled water cooling coil shall be sized to provide cooling/moisture removal of the capacity indicated on the equipment schedule. Tube arrangement shall be staggered and heat transfer shall be counter-flow. Coils shall have

brazed copper inlet and drainable outlet headers and iron connections. Supply and return connections shall be male pipe thread of the size scheduled. Both supply and return coil connections shall be located at the same end of the coil.

Coil shall be of internally finned 5/8-inch O.D. copper tubes mechanically bonded to configured aluminum plate fins with a 16 gauge galvanized steel casing. Tube wall shall be 0.025. Coil face velocity shall not exceed 500 feet per minute. Minimum clearance between coil and up/downstream device shall be 12" free to facilitate cleaning. Coils shall be secured to their respective supports with stainless steel hardware. Coils shall be leak tested at the factory to insure pressure integrity. The coils shall be rated at 250 PSIG. Coil shall be rated in accordance with ARI standards.

Coils shall have an integral all seam welded stainless steel drain pan with a minimum depth of two inches. Drain pan shall be part of the all welded floor, recessed, and sloped toward basins. Basins shall be provided minimum every 60" and allow for capture and cleaning of larger debris. Minimum basin size is 6" x 3" x 1.75" deep. Underneath of the entire drain pan, and basins, shall be insulated with spray urethane insulation positively preventing any underneath condensate from forming. Entire coil assembly, including safe-offs shall be inside of the recessed drain pan. Drain pans that sit on top of unit floor shall not be acceptable due to water management issues. An access door shall be provided on one side of the coil to allow coil removal.

All coils over 42 inches in length shall incorporate a 16 gauge galvanized tube support at the center of the fin length; coils over 96 inches in fin length shall incorporate additional tube supports. Coils shall be sealed around the perimeter (between the coil flanges and the unit casing channels) with silicone or polyurethane sealant to eliminate air bypass and prevent moisture carryover.

Hot Water Coil:

Hot water coil shall be sized to provide the capacity indicated on the equipment schedule. Tube arrangement shall be staggered and heat transfer shall be counter-flow. Coils shall have brazed copper inlet and drainable outlet headers and iron connections. Supply and return connections shall be male pipe thread of the size scheduled. Both supply and return coil connections shall be located at the same end of the coil.

Coil shall be of internally finned 5/8-inch O.D. copper tubes mechanically bonded to configured aluminum plate fins with a 16 gauge galvanized steel casing. Tube wall shall be 0.025. Coil face velocity shall not exceed 850 feet per minute. Minimum clearance between coil and up/downstream device shall be 12" free to facilitate cleaning. Coils shall be secured to their respective supports with stainless steel hardware. Coils shall be leak tested at the factory to insure pressure integrity. The coils shall be rated at 250 PSIG. Coil shall be rated in accordance with ARI standards.

An access door shall be provided on one side of the coil to allow coil removal.

All coils over 42 inches in length shall incorporate a 16 gauge galvanized tube support at the center of the fin length; coils over 96 inches in fin length shall incorporate additional tube supports. Coils shall be sealed around the perimeter (between the coil flanges and the unit casing channels) with silicone or polyurethane sealant to eliminate air bypass and prevent moisture carryover.

Piping Vestibule:

Provide factory piping vestibule of size shown on drawings. Vestibule shall include access door for access to control valves and piping accessories. Vestibule shall ship loose for field installation by installing contractor. Openings in bottom of vestibule shall be field cut by installing contractor as required. Vestibule option shall include provision for coil pull from one side.

Filters:

Filters must be provided standard on all air entering sides of air-to-air heat exchangers. Maximum face velocity shall be 500 feet per minute.

The following filters shall be provided:
4" deep MERV 13 outdoor air filters
4" deep MERV 8 exhaust air filters

Dial type filter gauges to indicate filter pressure drop.

Filter differential pressure switches wired to the unit electrical panel. Switch is set to close at dirty filter pressure drop.

Electrical:

An integral electrical control panel shall be provided that has hinged access doors and an approved locking device. All power wiring shall be brought to a common terminal strip and only a single point electrical connection shall be required.

A fused control power transformer shall be furnished. All components shall be fully wired and tested prior to shipment and all major electrical components shall be UL listed. Electrical system shall be ETL listed and labeled, in accordance with UL 1995. A main disconnect switch shall be factory mounted with rotary handle extending through the unit electrical enclosure. All wiring shall be connected to a numbered terminal strip for easy troubleshooting. Any conduit used shall not be run across or come into contact with the floor.

Accessories: GFCI receptacle powered from a step-down transformer wired to the line side of the main disconnect

Temperature and Humidity Controls:

Johnson Controls Series FEC2610 DDC controller shall be factory furnished, and wired to control the energy recovery unit. Other manufactured DDC controllers requiring integration through Bacnet shall not be acceptable.

All required temperature sensors and humidity transducers that are mounted in unit shall be provided as indicated in the control sequence. (Space humidity transducer and temperature sensor where applicable shall be provided by JCI and field mounted and wired by JCI). A coil freezstat shall be provided and facotry wired to controller. Dirty filter switches shall be provided. End switches shall be provided on dampers and shall not allow fan to start until damper is proved open. Wheel shall have rotation sensor.
Unit manufacturer shall provide complete controls sequence with points list in the submittal package.

Chilled water control valve shall be provided by JCI and shall be delivered to installing contractor for field installation. Control wiring from controller to control valve shall be performed by JCI

Hot water control valve shall be provided by JCI and shall be delivered to installing contractor for field installation. Control wiring from controller to control valve shall be performed by JCI

Startup and Warranty:

Provide factory check, test and start-up service.

Provide owner training at time to be designated by Owner.

Provide 1-year parts warranty on entire unit from project substantial completion. Labor warranty shall be responsibility of installing contractor.

VRV SPLIT SYSTEM HEAT PUMP UNITS:

Provide Daikin variable refrigerant volume split system heat pump unit(s) or approved equal (see Section 230010) of the type, arrangement, size, and indicated capacities and characteristics. The outdoor unit is a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. Operation of the system shall permit either cooling or heating of all of the indoor units.

The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark. The outdoor unit will be factory charged with R410A.

The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming. The unit shall incorporate an auto-charging feature and a refrigerant charge check function.

The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. The outdoor unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls. The system shall continue to provide heat to the indoor units while in the defrost mode.

The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

The condensing unit shall consist of one or more propeller type, direct-drive 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

The Daikin inverter scroll compressors shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor

capacity (INV frequency or STD ON/OFF) shall be controlled to eliminate deviation from target value. The capacity control range shall be as low as 6% to 100%. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector. The compressor shall be spring mounted to avoid the transmission of vibration.

Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local wired controller. The wired remote controller shall have the following features:

OPERATION	Start/Stop
	Operation Mode
	Temperature Setting
	60°F – 90°F Set Point Range
	Fan Speed
	Airflow Direction
MONITORING	Status
	Malfunction Flashing
	Malfunction Content
	Filter Sign
	Operation Mode
	Temperature Setting
	Permit/Prohibit Selection
	Fan Speed
	Airflow Direction
SCHEDULING	ON/OFF Timer
CONTROL MANAGEMENT	Field Setting Mode
	Group Setting
	Auto Re-Start

Provide complete system of air conditioning units and accessories as scheduled on the drawings. All units shall carry a one (1) year parts and labor warranty and a six (6) year compressor warranty.

DUCTLESS AIR HANDLING UNITS (WALL MOUNTED):

Provide Daikin ductless split system air handling unit(s) or approved equal (see Section 230010) of the type, arrangement, size, and indicated capacities and characteristics. Air handler shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature. A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment. The indoor units sound pressure shall range from 32 dB(A) to 35 dB(A) at low speed measured at 3.3 feet below and from the unit.

The air handler shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The front grille shall be easily removed for washing.

The unit cabinet shall be affixed to a factory supplied wall mounting template. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available. The fan motor shall be thermally protected.

Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested. The refrigerant connections shall be flare connections.

The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.

Provide with one (1) year parts and labor warranty.

PART 3 - EXECUTION

DUCTWORK, GENERAL:

Drawings show general arrangement of duct. Provide all ductwork required to complete installation and avoid interferences. Installation shall conform with applicable portions of Section 230010, General Provisions, HVAC. Fabricate ducts as job progresses, using actual job measurements and referring to architectural, structural, electrical, plumbing and equipment drawings in order to avoid conflicts. Where space limitations preclude use of ducts and fittings as shown, consult Engineer for instructions. All ductwork, offsets, fittings, etc. required to make a complete and efficiently operating installation are included in this contract and shall be fabricated and installed in accordance with SMACNA Standards for the application unless noted otherwise herein.

All duct dimensions shown on drawings are "inside clear". The sizes of acoustically lined ducts and dampers in ducts shall be increased accordingly. Ducts shall be smooth on inside.

Provide flexible duct connectors by Hardcast or equal at all ductwork connections to equipment with fans, motors or rotating components.

Install double thickness turning vanes in duct fittings having centerline radius less than 1-1/2 times width of duct.

Support ducts from building structure with 1 inch wide galvanized steel bands per SMACNA recommendations. Wire hangers and nylon straps will not be acceptable.

Do not install runout drops to ceiling diffusers until ceiling grids have been installed. Center ceiling diffusers between grids.

Seal all joints in supply, return and exhaust ducts with Childers CP-145 Veloseal water based synthetic duct sealant, or equal.

Upon complete installation of ducts, clean entire system of rubbish, plaster, dirt, etc. before installing any outlets. After installation of outlets and connections to fans are made, blow out entire system with all control devices wide open.

FIRE DAMPERS:

Fire dampers shall be securely anchored to floor or wall, and installed by bolting retaining angles to the sleeve on each side of the wall. Wall and floor penetrations shall be fire sealed with an approved UL listed firestop system as manufactured by 3M or equal for the wall or floor type penetrated. A suitable access door shall be provided for each fire damper. In accordance with the requirements of the International Building Code, contractor shall permanently mark any access doors or other openings that serve as a means of access to fire dampers with ½" letters reading "Fire Damper". Label shall be permanently and securely attached.

PIPING, GENERAL:

All piping shall conform with Section 230010 - General Provisions - HVAC.

Provide a flange or union in screwed or welded pipe where pipe connects to equipment. At control valves, install union in each pipe connecting to the device. Screwed unions shall not be installed where they will be subjected to bending stresses, as in expansion loops or offsets.

Provide flexible pipe connectors at all piping connections to pumps.

Run pipes parallel to walls and ceilings. Wherever pipes change size, use eccentric fittings. Run piping so as not to obstruct walking or service areas.

Pipe and equipment locations shown are approximate. Exact location of equipment, pipes, and chases to be as approved and determined in field to avoid other pipes and maintain structural clearances. Use actual job dimensions and equipment shop drawings for roughing.

Piping to comply with best trade practice. Provide clearance between pipe and building structure so pipes can expand without damage to building structure.

Install manual air vents at all high points in piping system and 1/2" drain valves at all low points in piping system.

Pipe water relief drains, blowdown, and other drains to, but not into, the most convenient floor drain or where otherwise directed.

When soldering refrigerant pipe joints, a dry nitrogen purge shall be required through the inside of the pipe to prevent oxidation.

CHEMICAL WATER TREATMENT:

After hydrostatic pipe testing the closed loop heating and cooling water system shall be pre-treated and post-treated to clean the pipe system and provide corrosion resistance.

For initial cleaning, air handlers, coils and heat exchanger shall be isolated. Provide a liquid alkaline cleaner to clean the pipe systems. Cleaner shall be circulated for 8 hours minimum. Bleed and feed water until the total dissolved solids <500 uS/cm, the pH <7.8, and there is no visible color or suspended soils. Clean all strainers open all valves and circulate water for one hour. Flush all water from system.

For final treatment provide sufficient scale and corrosion inhibitor immediately after flushing.

EQUIPMENT, GENERAL:

All equipment specified herein shall be installed in accordance with manufacturer's published installation instructions and these specifications. All items shall have adequate clearances for access and maintenance. Each item of equipment shall be performance tested to verify compliance with specifications. Certified data sheets of successful performance tests shall be included in operating manuals.

SUBMITTALS:

Provide submittals as required in Section 230010. At completion of work, submit check-out report of automatic control system. Submit start up reports per Section 230010. Submit test and balance report per 230010. Submit manufacturer's installation, operation, and maintenance instructions.

End of Section 230500

SECTION 230548 - VIBRATION ISOLATION AND SEISMIC RESTRAINT

PART 1 – GENERAL

The work in this section consists of furnishing engineering and materials necessary for vibration isolation and seismic restraints for equipment contained herein for the project. All mechanical equipment 3/4 HP and over listed in the Vibration Isolation / Seismic schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure. All isolation materials, flexible connectors and seismic restraints shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner. The contractor and manufacturer of the isolation and seismic equipment shall refer to the isolator and seismic restraint schedule which lists isolator types, isolator deflections and seismic restraint type. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections.

Unless otherwise specified, all mechanical, and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping, and duct work in a captive position. Restraint devices shall be designed and selected to meet the seismic requirements as defined in 2009 IBC.

SEISMIC RESTRAINT SHALL NOT BE REQUIRED FOR THE FOLLOWING:

1. Hanging, wall mounted, and flexibly supported mechanical, plumbing and components that weigh 20 pounds (89 N) or less, where I p = 1.0 and flexible connections are provided between the components and associated duct work, piping and conduit.
2. Piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches (305mm) for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolation hanger connection to structure).
3. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) designated as having an Ip = 1.5 and a nominal pipe size of 1 inch or less where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment. Note, any combination of piping supported on a trapeze where the total weight exceeds 10 lb/ ft. must be braced.
4. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) designated with an Ip = 1.0 and a nominal pipe size of 3 inch and less and provisions are made to avoid impact with other structural or nonstructural components.
5. HVAC ducts suspended from hangers that are 12 inches or less in length from the top of the duct to the supporting structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2" from the top of the duct.
6. HVAC ducts that have a cross sectional area of less than 6 square feet and where provisions are made to avoid impact with larger ducts or mechanical components.
7. Equipment items installed in-line with the duct system (e.g, fans, heat exchangers and humidifiers) with an operating weight less than 76 pounds. Equipment must be rigidly attached to duct at inlet and outlet.

MANUFACTURER'S RESPONSIBILITIES:

Manufacturer of vibration and seismic control products shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.
3. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.
4. Provide calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified & stamped by an engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience and licensed in the project's jurisdiction. Provide calculations for all floor or roof mounted equipment, all suspended or wall mounted equipment 20lbs or greater, and vibration isolated equipment 20lbs or greater.
5. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges.
6. The seismic supplier shall provide a certificate of professional liability insurance for the seismic engineer for an amount not less than $1,000,000.00.

SUBMITTALS:

Submit shop drawings of all isolators, seismic restraints and calculations provided. The manufacturer of vibration isolation products shall submit the following data for each piece of isolated equipment: clearly identified equipment tag, quantity and size of vibration isolators and seismic restraints for each piece of rotating isolated equipment. Submittals for mountings and hangers incorporating springs shall include free height, rated deflections, and solid load. Submittals for bases shall clearly identify locations for all mountings as well as all locations for attachment points of the equipment to the mounting base. Submittals shall include seismic calculations signed and checked by a qualified licensed engineer in the employ of the manufacturer of the vibration isolators. Catalog cut sheets and installation instructions shall be included for each type of isolation mounting or seismic restraint used on equipment being isolated.

Provide shop drawings indicating location of all specification SC cable restraints (section 2.3.2) required for pipe and ductwork. Drawings must be stamped by manufacturer's registered professional engineer.

Mechanical, electrical and plumbing equipment manufacturers shall provide certification that their equipment is capable of resisting expected seismic loads without failure. Equipment manufacturers shall provide suitable attachment points and/or instructions for attaching seismic restraints.

PART 2 - PRODUCTS

QUALITY CONTROL:

The isolators and seismic restraint systems listed herein are as manufactured by Mason Industries, Kinetics, or approved equals which meet all the requirements of the specifications, are acceptable. Manufacturer must be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA). Non-isolated seismic rated curbs by Imperial Metals are acceptable.

Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

All isolators, bases and seismic restraints exposed to the weather shall utilize cadmium plated, epoxy coat or PVC coated springs and hot dipped galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

VIBRATION ISOLATORS:

Specification W: Pad type mounting consisting of two layers of ribbed elastomeric pads with a ½" poro-elastic vibration absorptive material bonded between them. Pads shall be sized for approximate deflection of 0.10" to 0.18".

Specification B: Adjustable, freestanding, open spring mounting with combination leveling and equipment fastening bolt. The spring shall be welded to the spring mounting baseplate and compression plate for stability. The isolator shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. An elastomeric pad having a minimum thickness of 1/4" shall be bonded to the baseplate. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. This type isolator must be used with specification SL seismic restraint (section 2.3.1). Isolators shall be Amber/Booth Type SW.

BASES:

Specification J: Concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6" deep. The base shall be sized with a minimum overlap of 4" around the base of the equipment and, in the case of belt-driven equipment, 4" beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF.

SEISMIC RESTRAINTS:

Specification SC: Restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to braced component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per ASCE 19 Structural Applications of Steel Cables for Buildings and ASTM A630. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

ROOFTOP UNIT CURBS AND ISOLATION SYSTEMS:

Specification X: Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough to provide continuous perimeter

support for rooftop unit. Curb must provide means to positively anchor to concrete deck, or bolt or weld directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Curb shall use minimum 18 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.) and/or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Seismic equipment rails shall be Imperial Metals Model MR-NC, 18" high.

PART 3 – EXECUTION

Isolator and seismic restraints shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 3/4 hp and over per the isolation schedule and these specifications.

INSTALLATION:

Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping. Locate isolation hangers as near the overhead support structure as possible. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of 1inch clearance below base will result when supported equipment has been installed and loaded for operation.

Seismic Rated roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable. Shimming of seismic rated curbs is not allowed.

Housekeeping Pads shall be constructed and installed per ASHRAE's "A Practical Guide to Seismic Restraint". They shall be a minimum of .5" thicker than the maximum embedment required of any anchor but not less than 6". They shall be sized to provide minimum edge distances for all installed anchors. They must be anchored to the floor structure in an approved manner.

Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All anchor bolts to steel shall be ASTM A307 or better

APPLICATION OF SEISMIC RESTRAINTS:

Isolated Equipment:

All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4) in conjunction with type B isolators. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.

All suspended isolated equipment and vessels shall be protected with specification SC restraints. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

Rigidly Mounted Equipment:

Floor mounted equipment shall be protected by properly sized anchor bolts with elastomeric grommets provided by the isolation manufacturer. Suspended equipment shall be protected with type SC bracing.

Duct Work:

Duct work 6 square feet and larger in cross sectional area shall be protected in all planes by type SC restraints. Locations shall be determined by the isolator supplier and shall include, but not be limited to: (1) at equipment connections as required to protect the connections. (2) at all duct runs and duct run ends (transverse bracing and longitudinal bracing not to exceed spacing specified in SMACNA guidelines).

End of Section 230548

SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

WORK INCLUDED:

General Requirements: This section shall include all insulation as required for installation on all items as specified hereinafter and/or as indicated. All insulations shall be installed in a workmanlike manner by qualified workers in the employment of an independent insulation contractor. Costs of insulation shall be included as part of work by contractor as applicable to his section of work. No separate bid is to be included for insulation work.

Fire hazard classification for all material shall not exceed flame spread of 25 and smoke development of 50 as classified by Underwriters Laboratories under Test Method ASTM E-84 and acceptable under NFPA Standards. This is to apply to the complete system and be a composite rating of insulation material with jacket or facings, vapor barrier, joint sealing tapes, mastic and fittings.

Prior to commencing any work, submit data sheets for engineer's approval of all material proposed to be used on this project.

PART 2 - PRODUCTS

ABOVE GROUND PIPING:

Pipe Insulation:

All water piping shall be insulated with heavy density fiberglass with all-service jacket Owens-Corning Double Self-Sealing Lap, ASJ/SSL-II, one piece, to be used on all lines above and below ambient temperature from 0°F to 850°F.

In block walls as construction progresses upwards, use Armstrong Company's AP2000 self-seal Armaflex, or equal by Armacell, in a thickness adequate to maintain an insulation surface temperature of 84°F. Miter elbows and seal with adhesive. Coat all joints with Childers CP-30 LO or CP-35 WB Vapor Barrier Coatings or equal per Section 230010.

Refrigerant Pipe Insulation:

Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular form equal to APArmaflex, APArmaflex W, APArmaflex SS, or APArmaflex SA. This product meets the requirements as defined in ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in tubular form." Insulation materials shall have a closed-cell structure to prevent moisture from wicking which makes it an efficient insulation. Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOC's, fiber free, dust free and resists mold and mildew.

Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested inaccordance with ASTM E 96, Procedure A, latest revision.

JACKET FOR EQUIPMENT ROOM PIPING:

All insulated piping in equipment rooms shall be covered with eight (8) ounce cotton canvas manufactured in the United States. All hot water piping shall be lagged with Childers CP-9, CP-10 or CP-11 Weather Barrier Coating, or equal. All chilled water piping shall be lagged with Childers CP-30 LO Solvent thinned Vapor Barrier Coating or CP-35 Water Based Vapor Barrier Coating, or equal.

JACKET FOR OUTDOOR PIPING:

All insulation outside (including insulation options) shall be protected with aluminum jacketing with factory applied moisture barrier. The aluminum jacketing shall be 0.016 thickness and be of 3003 alloy and H-14 temper. Jacketing shall be applied with 2-inch circumferential and 1-1/2 inch longitudinal lap and secured with 3/8 inch wide aluminum bands, 8 inches on center.

All elbows shall be covered with 2 piece aluminum insulation covers, manufactured from 110 aluminum alloy in .024" thickness, Childers Aluminum E11-Jacs or equal.

On hot service, aluminum elbows may be attached using self-tapping screws. On chilled water service, aluminum elbows shall be glued on pipe insulation.

PIPE INSULATION THICKNESS:

Piping for the following systems shall be insulated to the thickness listed:

Item	Insulation Thickness (Inches)
Fiberglass K = 0.24 Armaflex K = 0.25	
Cold Pipes:	
Chilled Water (Supply & Return)	
Pipe up to 1-1/2"	1"
Pipe 2" and above	1-1/2"
Condensate Drain Piping	1"
Refrigerant Suction	1"

Hot Pipes:

Steam and Condensate

Pipe up to 1"	2-1/2"
Pipe 1-1/2" to 3"	3"
Pipe 4" and above	4"

Hot Water (Heating Supply & Return)

Pipe up to 1-1/2"	1"
Pipe 2" and above	1-1/2"

Pumped Condensate or
Gravity Condensate

Pipe up to 1"	1-1/2"
Pipe 1-1/2" and above	2"

DUCTWORK INSULATION:

Foil tape is not acceptable to use on duct insulation and will be required to be removed if applied.

Supply, Return, and Fresh Air Return Ducts in Equipment Rooms:

Insulation shall be 1-1/2 inch thick board equal to Owens Corning 705 (FRK) (ASJ).

Return Transfer Ducts and Sound Elbows on Grilles:

Line all metal ducts with 1-1/2 pound density, 1 inch thick duct liner equal to Owens Corning Aeroflex PLUS. Liner shall meet requirements of ASTM C1338, G21 and G22 with respect to resistance to microbial growth.

Supply, Return and Fresh Air Return Ducts in Plenums Not Specified to be Lined:

Insulate all non-lined metal ducts with 2 inch thick, 3/4 pound density duct wrap with FRK vapor barrier equal to Owens Corning Fiberglas All Service Duct Wrap.

Supply, Return and Fresh Air Return Ducts in Return Plenums Not Specified to be Lined:

Insulate all non-lined metal ducts with 2 inch thick, 3/4 pound density duct wrap with FRK vapor barrier equal to Owens Corning Fiberglas All Service Duct Wrap.

Duct Insulation (Flexible, Internal):

Line all supply and return ducts as noted on drawings with 1-1/2 pound density, 1 inch thick duct liner equal to Owens Corning Aeroflex PLUS. Liner shall meet requirements of ASTM C1338, G21 and G22 with respect to resistance to microbial growth.

Plenums and Casing Insulation (Internal):

All plenums and casings shall be internally lined with 3.0 pound density, 1-1/2 inch thick duct liner equal to Owens Corning Aeroflex PLUS. Liner shall meet requirements of ASTM C1338, G21 and G22 with respect to resistance to microbial growth.

OUTDOOR DUCT INSULATION:

Insulate all sheet metal duct work outdoors exposed to the weather with 2 inch thick Owens-Corning 705 insulation board with FSK factory applied facing. Seal all joints of metal duct with Childers CP-145A prior to installing insulation.

EQUIPMENT INSULATION:

Hot Vessels (to 400°F)

Hot tanks and vessels operating at temperatures not over 400°F shall be insulated with the thickness of insulation board as outlined below. Insulation board shall be pre-formed, flat rectangular rigid material. Maximum K value shall be .24 at 75°F mean temperature.

All vessels storing fluids, or connected to systems containing fluids, at temperatures between 150°F to 400°F shall be insulated.

Equipment	Insulation Thickness
Expansion Tank and Air Release Tank	1"
Heat Exchanger	2"
Condensate Receiver	2"
Hot Water Pumps	1-1/2"

Cold Vessels:

Cold vessels shall be insulated with foam plastic sheet, nominal 5 pound density, k factor .28 maximum at 75°F mean, 0.17 permeance, flame spread 25 or less, temperatures 40°F to 200°F.

Equipment	Insulation Thickness
Expansion Tank & Air Release Tank	3/4"
Chilled Water Pumps	3/4"

Fan Coil Unit Drain Pans	1/2"

PART 3 - EXECUTION

PIPE INSULATION:

All insulation shall be applied to clean, dry surfaces butting all sections firmly together and finishing as specified hereinafter.

All vapor barriers shall be sealed, and shall be continuous throughout. No staples shall be used on any vapor barrier jacket unless sealed with vapor barrier coating or vapor barrier tape.

Insulation of all insulated lines shall be interpreted as including all pipe, valves, fittings and specialties comprising the lines, except flanged unions and screwed unions on hot piping.

Valves and unions on chilled water piping shall have oversized insulation applied and sealed with CP-30 LO or CP-35.

Where sectional insulation is not practical, the proper insulation cement or block insulation shall be utilized by forming it to the applied surface.

Insulation over fittings and soil pipe hubs shall be of equal thickness as the adjoining pipe insulation.

Pipe Insulation Protection: Direct contact between pipe and hangers shall be avoided. Hanger shall pass outside of a sheet metal protection saddle which shall cover a section of high density insulation (cellular glass or calcium silicate), of sufficient length to support the weight of the pipe without crushing the insulation. The vapor barrier shall be continuous behind the saddle or shall be lapped over the saddle and securely cemented thereto.

Flow measurement: Provide a removable section of insulation for each pump at location designated by the engineer. Removable section shall be approximately 18 inches long and shall consist of two (2) 1/2" layers of Armaflex, or approved equal, with staggered joints. Insulation shall be held in place by three (3) Velco straps and be fully removable and replaceable without disturbing adjacent pipe insulation. All joints shall retain vapor seal integrity.

All pipe covering shall be furnished with self-seal lap and 3" wide butt joint strips. The release paper is pulled from adhesive edge, pipe covering closed tightly around pipe and self-seal lap rubbed hard in place with the blunt edge of an insulation knife. This procedure applied to longitudinal as well as circumferential joints. Staple all longitudinal and circumferential joints with 9/16" staples 6" on center and seal over all staples with Childers CP-30 vapor barrier coating. Care shall be taken to keep jacket clean as it is the finish on all exposed work. All adjoining insulation sections shall be firmly butted together before butt joint strip is applied, and all chilled water and cold water service lines shall have vapor barrier coating thoroughly coated to pipe at butt joints and at all fittings. All fittings, valve bodies, unions, and flanges shall be finished as follows:

To the hot insulated fittings, apply a tack coat of Childers CP-10 or CP-11 (use CP-35 on cold piping) at the rate of 2 gallons per 100 S.F. While the tack coat is still wet, a layer of 10 x 10 fiberglass reinforcing mesh shall be embedded with all fabric seams overlapped a minimum of 2". A finish coat, at a coverage rate of 4 gallons per 100 S.F. shall be applied, fully covering the reinforcing mesh.

Apply fiberglass inserts to all other hot fittings and cold water fittings in conjunction with Proto PVC Fitting Covers. Seal cold applications as recommended by the manufacturer.

Refrigerant Pipe Insulation: Armaflex insulation shall be slip fit over all tubing. Under no circumstances shall insulation be slit to fit over pipe already in place. Sufficient length shall be provided at all bends or turns to prevent the insulation from being pulled too tight and cracking. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLVAdhesive. Direct contact between pipe and hangers shall be avoided. Hanger shall pass outside of a sheet metal protection saddle which shall cover a section of high density insulation (cellular glass or calcium silicate), of sufficient length to support the weight of the pipe without crushing the insulation. The vapor barrier shall be continuous behind the saddle or shall be lapped over the saddle and securely cemented thereto.

APPLICATION VERTICAL VESSELS AND PIPE GREATER THAN 35" O.D.:

Insulation shall be furnished with a factory applied ASJ facing.

For application to piping and vessels operating between 0°F. and 55°F., apply a minimum 3" wide ASJ matching tape over the joints for proper vapor seal.

For application to piping and vessels operating between -50°F. and 0°F., apply a bead a CP-76 joint sealant before applying a minimum 3" wide ASJ matching tape over the joint for proper vapor seal.

ALUMINUM JACKET:

Jacketing shall be applied with 2-inch circumferential and 1-1/2 inch longitudinal lap and secured with 3/8 inch wide aluminum bands, 8 inches on center and at joints.

DUCTWORK INSULATION:

Foil tape is not acceptable to use on duct insulation and will be required to be removed if applied.

Board Insulation (External):

Board shall be applied by means of resistance welded mechanical fasteners or equal. Pins shall not be less than 3 inches in from each edge or corner of board and no more than 12 inches on center. Cut side pieces of insulation to lap top and bottom and scribe board to fit irregular surfaces. Apply a three inch wide bank of Childers CP-30 LO or CP-35 Vapor Barrier Coating on all joints of insulation. While tack coat is still wet, embed 3-inch wide White 10 x 10 Fiberglass reinforcing mesh and recoat fully covering the mesh. Pins shall not protrude excessively above fastening washers. Spot all washers with Childers CP-30 LO and cover with material to match jacket.

Flexible Insulation (External):

Application: Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped to the bottom of the rectangular duct. On ductwork over 24 inches wide, secure insulation with suitable resistance welded mechanical fasteners at not more than 18 inches on center. The 2-inch flange on the facing shall be stapled with 9/16 inch flare door stainless steel staples on 6 inch centers. Apply a three inch wide bank of Childers CP-30 LO or CP-35 Vapor Barrier Coating on all joints of insulation. While tack coat is still wet, embed 3-inch wide White 10 x 10 Fiberglass reinforcing mesh and recoat fully covering the mesh. Spot all pin penetrations or punctures in the insulation with a full coat of CP-30 LO or CP-35.

Flexible Insulation (Internal):

Applications: Duct Liner shall be applied to the interior of metal ducts using Childers CP-121 HV Duct Liner Adhesive or an equal product having a flame spread of less than 25 and a smoke development of less than 50 and classified such by Underwriters Laboratories. Exposed edges of insulation shall be coated with a heavy layer of Childers CP-135 CHIL-SPRED to eliminate erosion of fibers.

When duct height or plenum walls exceed 24 inches and when duct widths exceed 12 inches, resistance welded mechanical fasteners will be used in addition to duct liner adhesive. Fasteners shall start within 3 inches of the upstream transverse edges of the liner and 3 inches from the longitudinal joints. Fasteners should be spaced a maximum of 6 inches on center around the perimeter of the duct, except that they may be a maximum of 6 inches from a corner break. Elsewhere they shall be a maximum of 18 inches on center.

Insulation shall extend the full length of each duct section to permit butting firmly at the duct joints. All joints shall be tightly sealed with CP-135.

Plenums and Casing Insulation (Internal):

Insulation shall be applied to sheet metal surfaces which have been wiped clean and dry in the following manner:

Fasten insulation to sheet metal with coated surface facing the airstream side of the duct using Childers CP-121 HV Duct Liner Adhesive or equal. Additionally, secure liner with mechanical fasteners in accordance with Plate 2 of SMACNA "Duct Liner Standards". Coat all joints with Childers CP-135 CHIL-SPRED sealer.

Apply a 1/2 inch mesh galvanized wire 16 gauge (.063) over the entire surface of the board and secure with speed washers.

OUTDOOR DUCT INSULATION:

Insulation board shall be applied by means of resistance welded mechanical fasteners 12 inches on center and secured with a full coat of Childers CP-85 CHIL-STIX Clear UL Classified Adhesive or approved equal. Pins shall not be less than 3 inches in from each edge or corner of board. Cut side pieces of insulation to lap top and bottom, and scribe board to fit irregular surfaces. Pins shall protrude 1/8 to 3/16 inch above insulation. Apply Childers CP-76 Sealant (about the size of a pea) under the washer before pressing it down.

Apply a tack coat of Childers CP-10/11 to the outside of the duct at a rate of 2 gallons to 100 S.F. While the coating is still wet, embed into it a layer of CHIL-GLAS 5 (5 x 5 weave). Apply a finish coat at a rate of 4 gallons per 100S.F. fully covering the fiberglass reinforcing mesh., so that the minimum dry film thickness is 1/16 inch. Follow manufacturer's "Suggested Application Procedures" on data sheet.

(Cold Ducts):

After the VI-CRYL CP-10/11 coating has dried completely, apply a uniform coat of Childers ENCACEL V or ENCACEL X vapor barrier coating at a coverage rate of 6 gallons per 100 S.F.

EQUIPMENT INSULATIONS:

Equipment Insulation for Hot Vessels (to 400°F)

Insulation shall be cut and mitered where necessary to fit the contour of the vessel. For round vessels, insulation shall be banded in place with 1/2 inch x .020 stainless steel bands 18" on center. For flat or irregular vessels, insulation shall be impaled over weld pins and secured with speed washers. Apply a smoothing coat of One Shot Cement.

Apply metal lathe over the insulation, lacing edges on round vessels and securing to the weld pins with speed washers on flat and irregular vessels. Apply 1/2 inch coat of One Shot Cement and let thoroughly dry before applying finishing mastic.

Apply a tack coat of Childers CP-10/11 Vinyl Acrylic Mastic on hot vessels by brush. Embed a layer of Childers CHIL-GLAS 5 (5 x 5 weave) reinforcing mesh into wet coating, smoothing to avoid wrinkles. A finish coat at a coverage of 4 gallons per 100 S.F. shall be applied fully covering the reinforcing mesh so that the minimum dry film thickness is
1/16 inch.

Equipment Insulation for Cold Vessels:

Application:

Insulation shall be cut and mitered where necessary to fit the contour of the vessel. Cover the area of the size of one foamed plastic sheet with Rubatex Adhesive No. 373. Cover the back of the flexible sheet with the same, leaving 1/2 inch wide uncoated border around the outside edge. Let the adhesive dry to the touch before applying. Align sheet to overlap edges of the sheets in place by 1/8". Then press center of the sheet to adhere. Pressure butt edges into place for a tight joint. Roll the rest of the sheet for firm adhesion to surface. Spread the butt joints with a small brush, coat the edges and align for good appearance. Stagger all joints as applicable to horizontal or vertical installation. Do not fill the butt joints with adhesive. If painting is required, use two (2) even coats of Rubatex Mastic No. 374 (white), or equal, colored for desired purposes. Wipe the sheet with a cloth dampened with a non-oily solvent to remove powder before painting.

Apply a tack coat of Childers CP-30 LO or CP-35 on cold vessels by brush. Embed a layer of Childers CHIL-GLAS 5 (5 x 5 weave) reinforcing mesh into wet coating, smoothing to avoid wrinkles. A finish coat at a coverage of 4 gallons per 100 S.F. shall be applied fully covering the reinforcing mesh so that the minimum dry film thickness is 1/16 inch.

Pumps:

Insulation shall be fitted (boxed) around the water pumps so as to include the pump volute, the bearings and the portion of the base under the volute and bearings.

The upper portions of the insulating box, above the centerline of the pump shaft, shall be made up as a separate and easily removable box to permit access to the pump and bearings. The box shall be made up of #22 gauge galvanized sheet steel.

Fan Coil Drain Pans:

Insulate underside and sides of main drain pans with all edges sealed with CP-30. Insulation shall be applied to a dry drain pan with Armstrong adhesive.

Chiller Water Boxes:

The removable heads and water boxes of the chiller shall be covered with a four section galvanized steel box, lined with glass rigid equipment insulation impaled over weld pins and secured with speed washers. The four sections shall be bolted together with 1/4" bolts on 6-inch centers through and outstanding flange.

End of Section 230700

SECTION 230900 – CENTRAL CONTROL AND MONITORING SYSTEM

PART 1 – GENERAL

1.1 Related Documents

a. All work of this Division shall be coordinated and provided by the single Central Control and Monitoring System (CCMS) Contractor.

b. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

c. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

1.2 Scope

a. This section includes the controls, instrumentation and associated piping and wiring required to make the mechanical systems provided under Division 23 perform as described in these specifications and as shown. Provide a complete system of automatic temperature control of the direct digital type. The system shall be complete in all respects including all labor, materials, equipment, and service necessary, and shall be installed by personnel in the direct employ of the manufacturer. Provide a distributed process network control system complete with all necessary hardware and software including all programming. The DDC systems for South Tower Dorm shall be compatible with the existing USC campus wide control system network in all respects. The existing control system network is Johnson Controls Metasys.

b. Provide a complete and operational Central Control and Monitoring System (CCMS) including all devices and software necessary to perform the functions herein described or indicated on the drawings.

c. The CMMS shall be a Web based system communicating over the building owners Local Area Network (LAN). Contractor shall be responsible for coordination with the owner's IT staff to ensure that the CMMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN. TCP/IP connections and addresses shall be provided by the owner for connection of supervisory panels to the USC network..

d. The primary desktop and laptop interface will be via a standard Web Browser such as Internet Explorer or Netscape. CMMS contractor shall provide software license(s) for CMMS access for a minimum of twenty concurrent users.

e. Utilize the existing CMMS server for the purpose of providing a location for archiving system configuration data, graphics and historical data such as trend data and operator transactions.

f. The primary focus of the Central Control and Monitoring System (CCMS) will be to monitor and control the new HVAC system components, air handling units, fans, heat exchangers, coils, valves, pumps, variable speed drives, trending, graphic functions, etc. The system shall be expandable to serve future equipment, systems, and auxiliary field devices.

g. CCMS contactor shall provide all DDC panels, power supplies, wiring, conduit, solenoid valves, relays, differential pressure transmitters, differential pressure switches, RTDS, pressure sensors, etc. necessary for a complete and operable automatic control system and DDC field panels and connecting LAN.

h. The systems engineering phase shall include the selection and integration of components into a complete system which will meet the performance and prescriptive requirements of the Contract, together with drawings, specifications, descriptions of operation, diagrams including system

architecture and other materials listed under "Submittals" paragraph of this Section. The successful contractor shall be responsible for all systems engineering.

1.3 Quality Assurance

a. Quality assurance for automatic control systems includes a multi-step program consisting of a pre-qualification procedure for manufacturer and installation specialist; a system engineering, products and shop drawing phase; installation; testing and adjusting; reporting; commissioning testing and verifications; operating instruction and training; and the submission of maintenance and operating manuals.

b. CMMS Contractor

i. The Central Control and Monitoring System (CMMS) herein specified shall be fully integrated and installed as a complete package by the Central Control and Monitoring System contractor. The System shall include all wiring, piping, installation supervision, calibration, adjustments, and checkout necessary for a complete and fully operational system.

ii. The CMMS Contractor shall be a factory owned branch office that is regularly engaged in the engineering, programming, installation and service of CMMSs of similar size and complexity. Bids by wholesalers, mechanical contractors, franchised dealers, applied partners or any other firm whose principal business is not that of manufacturing and installing automatic temperature control systems shall not be acceptable.

iii. The CMMS Contractor shall have a minimum of ten years experience with the complete, turnkey installation of CMMSs of similar size and technical complexity.

iv. The CMMS shall be complete in all respects and shall be provided, installed and commissioned by the CMMS equipment manufacturer. Equipment manufacturer shall be responsible for and warrant the proper installation and operation of the CMMS and control system equipment.

v. The following CMMS contractors are approved to provide and install the CMMS for this project subject to their ability to meet all requirements of this specification:

Johnson Controls, Inc

14 Woodcross Drive

Columbia, SC 29212

vi. Bid approval does not imply nor suggest compliance of specification requirements.

b. CMMS Products Manufacturer:

i. The CMMS architecture shall consist of the products of a manufacturer regularly engaged in the production of CMMSs, and shall be the manufacturer's latest standard of design. Controllers and DDC (Direct Digital Control) system components shall be current production products.

ii. All other equipment shall be the products of the CMMS manufacturers or of an approved manufacturer regularly engaged in production of specialized CMMS materials or equipment.

iii. Following is a list of acceptable CMMS products manufacturers:

Johnson Controls, Inc

14 Woodcross Drive

Columbia, SC 29212

iv. Bid approval does not imply nor suggest compliance of specification requirements.

1.4 Work Included and Interface Requirements

a. Installation of Central Control and Monitoring System (CMMS)

i. The CMMS contractor shall provide all necessary hardware and software to integrate the new control system with the existing USC campus CMMS. Integration means the ability to monitor, override, change setpoints, and provide real-time bi-directional dynamic data exchange between the new control system and the existing CMMS hardware and software.

ii. The existing USC campus CMMS is a Johnson Controls Metasys system. The CMMS is comprised of multiple supervisory controllers, monitoring and communicating with various building control systems over the USC campus Ethernet LAN system. The new building control system will be connected to, and communicate with, the existing campus CMMS over the USC campus Ethernet LAN

iii. All new control points, monitoring points and software points shall be added to the existing USC CMMS database and shall be available for monitoring and adjustment at any computer, with current copy of Microsoft Internet Explorer software (Release 6.0 or later), that is connected to the USC LAN.

iv. All new building software and databases shall be archived on the hard drive at the USC CMMS server. In the event that any building controller should lose its program that controller's archived software program shall be downloaded across the CMMS network from the CMMS server to the respective building controller.

v. The CMMS contractor will provide all necessary hardware, software, and labor to allow communication with all any computer, with current copy of Microsoft Internet Explorer (Release 6.0 or later), that is connected to the USC LAN.

vi. Integrity of the existing CMMS shall be maintained during installation.

vii. The new building control system shall be compatible in every respect with existing Metasys CMMS hardware and software. All new controllers shall be compatible with Metasys database and Metasys software development tools.

1.6 Submittals

a. Shop Drawings, Product Data, and Samples

i. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.

ii. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

iii. The CCMS Contractor shall correct any errors or omissions noted in the first review.

iv. At a minimum, submit the following:

1. CCMS network architecture diagrams including all nodes and interconnections.

2. Systems schematics, sequences and flow diagrams.

3. Points schedule for each point in the CCMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.

4. Samples of Graphic Display screen types and associated menus.

5. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
6. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
7. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
8. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
9. Details of all CCMS interfaces and connections to the work of other trades.
10. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.7 Record Documentation

a. Operation and Maintenance Manuals

i. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the CCMS provided:

1. Table of contents.
2. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
3. Manufacturers product data sheets or catalog pages for all products including software.
4. System Operator's manuals.
5. Archive copy of all site-specific databases and sequences.
6. CCMS network diagrams.
7. Interfaces to all third-party products and work by other trades.

ii. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.8 Warranty

a. Standard Material and Labor Warranty:

i. Provide a one-year labor and material warranty on the CCMS.

ii. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the CCMS Contractor at the cost of the CCMS Contractor.

iii. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during CCMS Contractor's normal business hours.

PART 2 – PRODUCTS

2.1 General Description

a. Central Control and Monitoring (CCMS) shall use an open architecture. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

b. Central Control and Monitoring System shall consist of the following:

i. Standalone Network Automation Engine(s)

ii. Field Equipment Controller(s)

iii. Input/Output Module(s)

iv. Local Display Device(s)

v. Distributed User Interface(s)

vi. Network processing, data storage and communications equipment

vii. Other components required for a complete and working CCMS

c. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

d. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.2 CCMS Architecture

a. Automation Network

i. The CCMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.

ii. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.

iii. Network Automation Engines (NAE) shall reside on the automation network.

iv. The automation network will be compatible with other campus-wide networks. Where indicated, the automation network shall be connected to the campus network and share resources with it by way of standard networking devices and practices.

b. Control Network

i. Network Automation Engines shall provide supervisory control over the control network.

ii. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.

iii. DDC Controllers shall reside on the control network.

c. Distributed Web Based User Interface

i. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.

ii. Alarms

1. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

a. Log date and time of alarm occurrence.

b. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.

c. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.

d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

e. Provide the capability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

f. Any attribute of any object in the system may be designated to report an alarm.

2. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

iii. Reports and Summaries

1. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

a. All points in the CCMS

b. All points in each CCMS application

c. All points in a specific controller

d. All points in a user-defined group of points

e. All points currently in alarm

f. All points locked out

g. All CCMS schedules

h. All user defined and adjustable variables, schedules, interlocks and the like.

2. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
3. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
4. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

iv. Schedules

1. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
    a. Weekly schedules
    b. Exception Schedules
    c. Monthly calendars.
2. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
3. It shall be possible to define one or more exception schedules for each schedule including references to calendars

v. Password

1. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
2. A minimum of five levels of access shall be supported individually or in any combination as follows:

Level 1 = View Data

Level 2 = Command

Level 3 = Operator Overrides

Level 4 = Database Modification

Level 5 = Database Configuration

Level 6 = All privileges, including Password Add/Modify

3. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

vi. Dynamic Color Graphics

1. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
2. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

a. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

vii. Historical trending and data collection

1. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:

a. Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:

Defined time interval

Upon a change of value

b. Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

2. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.

viii. Trend data viewing and analysis

1. Provide a trend viewing utility that shall have access to all database points.

2. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.

3. The trend viewing utility shall have the capability to define trend study displays to include multiple trends

4. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

5. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

6. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

7. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

2.3 Network Automation Engines (NAE)

a. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

i. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.

ii. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

iii. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

iv. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

v. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

2.4 DDC System Controllers

a. Field Equipment Controller (FEC)

i. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.

ii. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.

iii. The FEC shall be assembled in a plenum-rated housing with flammability rated to UL94-5VB.

iv. The FEC shall include a removable base to allow pre-wiring without the controller.

v. The FEC shall accommodate the direct wiring of analog and binary I/O field points.

vi. The FEC shall support the following types of inputs and outputs:

1. Universal Inputs - shall be configured to monitor any of the following:

Analog Input, Voltage Mode

Analog Input, Current Mode

Analog Input, Resistive Mode

Binary Input, Dry Contact Maintained Mode

Binary Input, Pulse Counter Mode

2. Binary Inputs - shall be configured to monitor either of the following:

Dry Contact Maintained Mode

Pulse Counter Mode

3. Analog Outputs - shall be configured to output either of the following

Analog Output, Voltage Mode

Analog Output, current Mode

4. Binary Outputs - shall output the following:

24 VAC Triac

5. Configurable Outputs - shall be capable of the following:

Analog Output, Voltage Mode

Binary Output Mode

vii. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

1. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
2. The FC Bus shall support communications between the FECs and the NAE.
3. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
4. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

viii. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

1. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
2. The SA Bus shall support a minimum of 10 devices per trunk.
3. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

ix. The FEC shall support, but not be limited to, the following:

1. Hot water, chilled water/central plant applications
2. Built-up air handling units for special applications
3. Terminal units
4. Special programs as required for systems control

2.5 Field Devices

a. Input/Output Module (IOM)

i. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.

ii. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.

b. Networked Thermostat (TEC)

i. The Networked Thermostats shall be capable of controlling the following:

1. A four pipe fan coil system with multi-speed fan control.
2. A two pipe fan coil with a single speed fan.
3. The Networked Thermostat shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Automation Engine.

ii. The Networked Thermostat shall include an intuitive User Interface providing plain text messages.

1. Two line, 8 character backlit display
2. LED indicators for Fan, Heat, and Cool status
3. Five (5) User Interface Keys
    a. Mode
    b. Fan
    c. Override
    d. Degrees C/F
    e. Up/Down

iii. The Networked Thermostats shall provide the flexibility to support the following inputs:

1. Integral Indoor Air Temperature Sensor
2. Duct Mount Air Temperature Sensor
3. Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
4. Two configurable binary inputs

iv. The Networked Thermostats shall provide the flexibility to support the following outputs:

1. Three Speed Fan Control
2. On/Off Control
3. Floating Control
4. Proportional (0 to 10V) Control

c. VAV Modular Assembly (VMA)

iii. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.

iv. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.

v. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.

vi. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

vii. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

viii. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

ix. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

x. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

xi. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

xii. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

xiii. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

xiv. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

xv. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

xvi. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

xvii. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

xviii. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

a. Absolute temperature loop error.

b. Signed temperature loop error.

c. Absolute airflow loop error.

d. Signed airflow loop error.

e. Average damper actuator duty cycle.\

xix. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

a. Unreliable space temperature sensor.

b. Unreliable differential pressure sensor.

c. Starved box.

d. Actuator stall

e. Insufficient cooling.

f. Insufficient heating.

2. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

xx. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.

xxi. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

xxii. Inputs:

1. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

a. 0-10 VDC Sensors

b. 1000ohm RTDs

c. NTC Thermistors

2. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

3. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

4. Provide side loop application for humidity control.

xxiii. Outputs

1. Analog outputs shall provide the following control outputs:

a. 0-10 VDC

2. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

3. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

xxiv. Application Configuration

1. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

xxv. Sensor Support

1. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.

2. The VMA shall support an LCD display room sensor.

3. The VMA shall also support standard room sensors as defined by analog input requirements.

4. The VMA shall support humidity sensors defined by the AI side loop.

d. Network Sensors (NS)

i. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:

1. Zone Temperature
2. Zone humidity
3. Zone setpoint

ii. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.

iii. The Network Sensors shall include the following items:

1. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
2. An LED to indicate the status of the Override feature.
3. A button to toggle the temperature display between Fahrenheit and Celsius.
4. A button to initiate a timed override command

iv. The NS shall be available with either screw terminals or phone jack.

v. The NS shall be available in either surface mount or wall mount styles.

2.6 Input Devices

a. General Requirements

i. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

b. Temperature Sensors

i. General Requirements:

1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
2. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

ii. Room Temperature Sensors

1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have the following options when specified:
   a. Setpoint reset slide switch providing a ± 3 degree (adjustable) range.
   b. Individual heating/cooling setpoint slide switches.
   c. A momentary override request push button for activation of after-hours operation.

iv. Thermo wells

1. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
2. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
3. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.
4. Thermo wells shall be constructed of 316 stainless steel.

v. Outside Air Sensors

1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
3. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

vi. Duct Mount Sensors

1. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

vii. Averaging Sensors

1. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
3. Capillary supports at the sides of the duct shall be provided to support the sensing string.

viii. Acceptable Manufacturers: Johnson Controls, Setra.

c. Humidity Sensors

i. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.

ii. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.

iii. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

iv. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.

v. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

vi. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

vii. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.

d. Differential Pressure Transmitters

i. General Air and Water Pressure Transmitter Requirements:

1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

2. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

4. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

ii. Low Differential Water Pressure Applications (0" - 20" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.

2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

a. .01-20" w.c. input differential pressure range.

b. 4-20 mA output.

c. Maintain accuracy up to 20 to 1 ratio turndown.

d. Reference Accuracy: +0.2% of full span.

3. Acceptable Manufacturers: Setra and Mamac.

iii. Medium to High Differential Water Pressure Applications (Over 21" w.c.)

1. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:

a. Differential pressure range 10" w.c. to 300 PSI.

b. Reference Accuracy: $\pm$1% of full span (includes non-linearity, hysteresis, and repeatability).

2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall

be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

3. Acceptable Manufacturers: Setra and Mamac.

iv. Building Differential Air Pressure Applications (-1" to +1" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

a. -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)

b. 4-20 mA output.

c. Maintain accuracy up to 20 to 1 ratio turndown.

d. Reference Accuracy: +0.2% of full span.

3. Acceptable Manufacturers: Johnson Controls and Setra.

v. Low Differential Air Pressure Applications (0" to 5" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

a. - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)

b. 4-20 mA output.

c. Maintain accuracy up to 20 to 1 ratio turndown.

d. Reference Accuracy: +0.2% of full span.

3. Acceptable Manufacturers: Johnson Controls and Setra.

vi. Medium Differential Air Pressure Applications (5" to 21" w.c.)

1. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

a. Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.

b. Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.

c. Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).

2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Acceptable manufacturers: Johnson Controls and Setra.

e. Flow Monitoring

i. Air Flow Monitoring

1. Provide airflow temperature measurement devices where indicated on the plans.
2. Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter. Each transmitter shall operate on 24VAC.
3. Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and averaged by the transmitter prior to output.
4. Each independent airflow sensor shall have a laboratory accuracy of +/-2% of reading over the entire operating airflow range of 0-5000FPM and be wind tunnel calibrated or verified against standards that are traceable to NIST.
5. The number of sensor housings provided for each location shall be

	Duct or Plenum Area (sq. ft)	Total # Sensors/Location
a.	<2	4
b.	2 to <4	6
c.	4 to <8	8
d.	8 to <16	12
e.	>=16	16

6. The transmitter shall be capable of communicating with the host controls using the following interface options:
7. Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4 wire)
8. RS-485: Field selectable Johnson Controls N2 Bus

a. Acceptable Manufacturers: Johnson Controls, Ebtron, Inc

ii. Water Flow Monitoring

a. Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.

b. Acceptable manufacturers: Onicon

f. Power Monitoring Devices

i. Current Measurement (Amps)

1. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
2. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

a. Operating frequency – 50 - 400 Hz.

b. Insulation – 0.6 Kv class 10Kv BIL.

c. UL recognized.

d. Five amp secondary.

e. Select current ration as appropriate for application.

f. Acceptable manufacturers: Veris Industries

3. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

a. 6X input over amp rating for AC inrushes of up to 120 amps.

b. Manufactured to UL 1244.

c. Accuracy: +.5%, Ripple +1%.

d. Minimum load resistance 30kOhm.

e. Input 0-20 Amps.

f. Output 4-20 mA.

g. Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

h. Acceptable manufacturers: Veris Industries

g. Smoke Detectors

i. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26, Fire Alarm System.

h. Status and Safety Switches

i. General Requirements

1. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the CCMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

ii. Current Sensing Switches

1. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

4. Acceptable manufacturers: Veris Industries

iii. Air Filter Status Switches

1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
2. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
3. Provide appropriate scale range and differential adjustment for intended service.
4. Acceptable manufacturers: Johnson Controls, Cleveland Controls

iv. Air Flow Switches

1. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
2. Acceptable manufacturers: Johnson Controls, Cleveland Controls

v. Air Pressure Safety Switches

1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
3. Acceptable manufacturers: Johnson Controls, Cleveland Controls

vi. Water Flow Switches

1. Water flow switches shall be equal to the Johnson Controls P74.

vii. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
4. The low temperature limit switch shall be equal to Johnson Controls A70.

2.7 Output Devices

a. Actuators

i. General Requirements

ii. Damper and valve actuators shall be electronic. Controls submittals shall include complete control diagrams and indicate actuator fail position as normally open or closed.

1. Electronic damper actuators shall be direct shaft mount.
2. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall

permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

3. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

4. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

5. Acceptable manufacturers: Johnson Controls, Mamac.

iii. Electronic Valve Actuators

1. Electronic valve actuators shall be manufactured by the valve manufacturer.

2. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

3. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

4. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

5. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

6. Acceptable manufacturers: Johnson Controls

b. Control Relays

i. Control Pilot Relays

1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting Bases shall be snap-mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120VAC.
5. Relays shall have an integral indicator light and check button.
6. Acceptable manufacturers: Johnson Controls, Lectro

c. Control Valves (Chilled Water)

i. All modulating control valves shall be of the "pressure independent" type configured with one integrated valve body that incorporates one chamber with an adjustable Cv and a separate pressure regulating chamber used to maintain a constant differential pressure across the control surface.

ii. Each control valve shall be individually flow tested at the factory and verified to deviate no more than ±5% through the selected operating pressure range. A calibrated performance tag shall be provided with each valve that verifies the flow rate in 10° rotation increments up to full rated flow (option with 1/2"). All testing shall be performed with instruments calibrated to the requirements of ANSI/ISA-S75.11-1985, with traceability to NIST and/or ISO standards.

iii. Control valve rangeability shall be 100:1 minimum.

iv. Each control valve shall be subjected to 70 psid and tested to exceed ANSI/FCI 70-2-1998 leakage ratings. Class IV leakage or better is required for control valves 2" nominal size and less. Class III leakage or better is required for control valves larger than 2".

v. In all control valves 8" and smaller, it shall be possible to modify the valve flow characteristics without removing the valve from the piping system.

vi. Balancing valves and associated balancing shall not be required where pressure independent modulating control valves are installed.

vii. The control valve actuator shall modulate all valves up to 8" in nominal size from 0 to 100% design flow while rotating the valve stem a maximum of 90°.

viii. There shall be three ports installed at the factory integral to each valve and capable of being used to measure pressure or temperature. The first port shall be installed at the inlet to the valve. The second shall be installed between the Cv chamber and the pressure regulating chamber. The third shall be installed at the outlet of the valve. Should the ports not be provided as part of the valve body than they shall be installed in a spool piece and attached to the body.

ix. The differential pressure between the first and the third port shall be used in commissioning to verify that the minimum differential pressure (typically 5 psid) required for pressure independent operation is available.

x. The differential pressure between the first and second ports shall be used to verify proper valve operation and flow regulation. It shall be possible to verify the flow rate through the control valve using the valve stem position and the differential pressure measurement

between the first and second port in the valve. If these valve features are not available, a flow meter shall be installed to verify actual flow rate in operation through the valve.

xi. All valves shall be warranted by the manufacturer for no less than 5 years from the date of purchase

xii. Acceptable manufacturers: Johnson Controls, Danfoss, Delta Flow

d. Control Valves (Hot Water & Steam Systems)

i. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

ii. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

iii. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.

iv. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.

v. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

vi. Acceptable manufacturers: Johnson Controls

2.8 Miscellaneous Devices

a. Local Control Panels

i. All control panels shall be factory constructed, incorporating the CCMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

ii. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so

forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.

iii. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.

iv. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

v. All wiring shall be neatly installed in plastic trays or tie-wrapped.

vi. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

b. Thermostats

i. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 – PERFORMANCE / EXECUTION

3.1 CCMS Specific Requirements

a. Graphic Displays

i. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

ii. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

b. Actuation / Control Type

i. Primary Equipment

1. Controls shall be provided by equipment manufacturer as specified herein.

2. All damper and valve actuation shall be electric.

ii. Air Handling Equipment

1. All air handers shall be controlled with a HVAC-DDC Controller

2. All damper and valve actuation shall be electric.

iii. Terminal Equipment:

1. Terminal Units (VAV, FPVAV, etc.) shall have electric damper and valve actuation.

2. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 Installation Practices

a. CCMS Wiring

i. All conduit, wiring, accessories and wiring connections required for the installation of the Central Control and Monitoring System, as herein specified, shall be provided by the CCMS

Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.

ii. All CCMS wiring materials and installation methods shall comply with CCMS manufacturer recommendations.

iii. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the CCMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the CCMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

iv. Class 2 Wiring

1. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

2. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.

v. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.

vi. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

b. CCMS Raceway

i. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".

ii. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

iii. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

iv. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

c. Penetrations

i. Provide fire stopping for all penetrations used by dedicated CCMS conduits and raceways.

ii. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

iii. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

iv. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

e. CCMS Identification Standards

i. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

1. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

f. CCMS Panel Installation

i. The CCMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

ii. The CCMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

g. Input Devices

i. All Input devices shall be installed per the manufacturer recommendation

ii. Locate components of the CCMS in accessible local control panels wherever possible.

h. HVAC Input Devices – General

i. All Input devices shall be installed per the manufacturer recommendation

ii. Locate components of the CCMS in accessible local control panels wherever possible.

iii. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

iv. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

v. Outside Air Sensors

1. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

2. Sensors shall be installed with a rain proof, perforated cover.

vi. Water Differential Pressure Sensors

1. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.

2. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.

3. The transmitters shall be installed in an accessible location wherever possible.

vii. Medium to High Differential Water Pressure Applications (Over 21" w.c.):

1. Air bleed units, bypass valves and compression fittings shall be provided.

viii. Building Differential Air Pressure Applications (-1" to +1" w.c.):

1. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.

2. The interior tip shall be inconspicuous and located as shown on the drawings.

x. Duct Temperature Sensors:

1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
2. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
3. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
4. The sensor shall be mounted to suitable supports using factory approved element holders.

xi. Space Sensors:

1. Shall be mounted per ADA requirements.
2. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

xii. Low Temperature Limit Switches:

1. Install on the discharge side of the first water or steam coil in the air stream.
2. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

xiii. Air Differential Pressure Status Switches:

1. Install with static pressure tips, tubing, fittings, and air filter.

xiv. Water Differential Pressure Status Switches:

1. Install with shut off valves for isolation.

i. HVAC Output Devices

i. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

ii. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.

iii. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

iv. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

v. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Central Control and Monitoring System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system,

provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training

a. The CCMS contractor shall provide the following training services:

i. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the CCMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.4 Commissioning

a. Fully commission all aspects of the Central Control and Monitoring System work.

b. Acceptance Check Sheet

i. Prepare a check sheet that includes all points for all functions of the CCMS as indicated on the point list included in this specification.

ii. Submit the check sheet to the Engineer for approval

iii. The Engineer will use the check sheet as the basis for acceptance with the CCMS Contractor.

c. VAV box performance verification and documentation:

i. The CCMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced and submitted to the engineer for review. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

ii. The CCMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data.

d. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.5 SEQUENCE OF OPERATION

a. GENERAL

i. Power - Fail Restart:

1. In the event of a power failure the FMS computer will analyze the status of all controlled equipment and compare it with normal occupancy scheduling. The equipment will then be started or stopped as necessary to prevent all equipment from coming on at the same time.

ii. FMS Monitoring:

1. Refer to the attached Input/Output schedule for a listing of all monitoring and override points and for additional software features.

iii. Optimal Start:

1. All scheduled HVAC equipment will be started based on an optimal start feature that will calculate the approximate time the unit will have to be started prior to

scheduled start time in order for the space temperature to be at setpoint at schedules occupancy.

2. Once space temperatures reach occupied setpoint O.A. dampers will be modulated open. Whenever the unit goes in the unoccupied mode the O.A. damper will be closed.

iv. Night High Limit and Night Low Limit:

1. During unoccupied periods scheduled fan powered VAV boxes will be energized whenever space temperature drops below a night low limit setpoint of 65 degrees(adjustable).

2. During unoccupied periods scheduled fan powered boxes, VAV boxes and associated AHU's will be energized whenever space temperature exceeds a a night high limit of 85 degrees(adj).

b. South Tower

i. CHILLED WATER SYSTEM:

1. Secondary Chilled Water Pump Start-Stop Control:

a. Building chilled water pumps will operate in a primary and standby configuration. In the event of a failure of a primary pump an alarm will be given at the FMS computer and the standby pump will automatically be started. Primary and standby pumps will be automatically alternated on a weekly basis.

2. Secondary Chilled Water Pump Speed Control:

a. Whenever the DDC controller detects that a pump is on, it will sense the differential pressure in the chilled water system and modulate the variable speed drive of that pump as required to maintain the differential pressure set point. Loop pressure set point shall be reset based on flow rate.

3. Chilled Water Temperature Control:

a. The chilled water for this building will be provided by the East Energy Facility. CHW return temperature back to the energy plant will be controlled at 57 degrees (adjustable) by modulating the main building CHW valve.

b. All hardware and software shall be provided to accomplish this control sequence but sequence and control shall be disabled upon initial startup and shall not be enable unless directed by the engineer.

ii. HOT WATER SYSTEM:

1. HW Pump Start Stop Control:

a. H.W. pumps will operate in a primary and standby configuration. In the event of a failure of a primary pump an alarm will be given at the FMS computer and the standby pump will be automatically started. Primary and standby pumps will be automatically alternated on a weekly basis.

2. Hot Water Pump Speed Control:

a. Whenever the DDC controller detects that a pump is on, it will sense the differential pressure in the hot water system and modulate the variable

speed drive of that pump as required to maintain the differential pressure setpoint. Loop pressure set point shall be reset based on flow rate.

3. Heat Exchanger Hot Water Temperature Control:

a. The DDC controller will sense the hot water supply temperature and outside air temperature in order to determine the hot water supply temperature setpoint. The setpoint will be reset according to the following adjustable reset schedule.

Outside Air Temperature	Hot Water Supply Temperature
20°F	180°F
65°F	120°F

b. The DDC controller will modulate the HEX steam control valves as required to maintain the calculated hot water supply temperature setpoint.

iii. Energy Monitoring:

1. Building CHW BTU Meter:

a. Existing Onicon electromagnetic flow meter and existing CHW BTU meter will be reused for monitoring of total building CHW consumption:

2. Building Steam BTU Meter:

a. Existing Spirax Sarco Diva Steam flow meter and Onicon BTU meter will be reused for monitoring of total building steam consumption:

3. Electrical consumption:

a. New Veris BACnet electrical power meter will be provided under this division for monitoring of total building KW consumption. Power meter will be BACnet compatible and will be connected to the CCMS under this contract.

iv. AHU-1 Variable Air Volume Unit

3. Start/Stop:

a. The unit will be capable of being started and stopped based on a time of day schedule from the FMS.

b. When the unit goes into the occupied mode and is to be started, the outdoor air damper will be driven to its minimum CFM position, as sensed by outdoor air CFM measuring device. The outdoor air damper will remain closed during night low limit and morning warmup. CO2 sensor shall be provided as as indicated on the drawings. Outdoor air damper shall be modulated to control maximum space CO2 levels to 650 PPM (adjustable) greater than the measured outdoor air CO2 levels.

Outdoor air damper will not be allowed to be closed past minimum CFM position when the unit is in the occupied mode.

4. Safeties:

   a. Duct smoke detector will shut the supply fan off whenever products of combustion are sensed. The smoke detector will be provided and wired back to fire alarm system by division 16 and interlocked with the fan starter under division 15.

   b. A temperature low limit switch will shutdown the fan whenever mixed air temperatures drop below 38 degrees .

   c. A static pressure high limit switch will shut down the air handler whenever static pressure in the discharge of the air handler exceeds 5" W.G.

5. Temperature Control:

   a. Discharge air temperature shall be controlled at 55 degrees F. (adjustable) by modulating the CHW valve as necessary to maintain setpoint.

6. Preheat Coil Discharge Air Control:

   a. Preheat coil discharge air temperature shall be controlled at 55 degrees (adjustable) by modulating preheat control valve as required to maintain setpoint.

7. Pressure Control:

   a. The supply variable speed drive shall be modulated to maintain supply duct static pressure setpoint of 1 in w.g.

   b. When the supply fan starts the VSD shall be in the "unloaded" position. VSD will load fan over an adjustable time period.

v. VAV Boxes

3. Each VAV box shall be controlled by a unit mounted DDC controller. On a call for cooling the air valve will be modulated as required to maintain room temperature setpoint. As space temperature drops below setpoint the air valve will be modulated to minimum position. On a continued drop in space temperature, the hot water reheat valve will be modulated open.

vi. Fan-coils.

3. General:

   a. Fan coil units will be controlled by a standalone DDC controller with wireless wall mounted room temperature sensor/command module.

   b. Command module shall be provided with fan speed override button that will provide local unit start/stop, automatic speed control and manual fan speed adjustment from low speed, to medium speed to high speed. Command module shall also be provided with setpoint adjustment and digital display for local readout of room temperature, room temperature setpoint and fan command status (i.e. on/off, low speed/medium speed/high speed).

   c. Provide supply air discharge temperature sensor for monitoring only.

4. Safeties:

    a. Provide drain pan float switch to shutdown FCU fan and close control valves when float switch goes into alarm.

5. Start Stop:

    a. Each FCU will run continuously but will have the ability to be started and stopped by the FMS system or the local fan speed switch.

6. Temperature Control:

    a. Room temperature, as sensed by wall mounted room temperature sensor, will be controlled by modulating the fan coil unit CHW and HW control valves as required to maintain return air temperature setpoint. In the auto mode fan will cycle from low to medium to high speed based on room temperature.

7. FCU Energy consumption:

    a. Daily BTU consumption for each dorm room fan coil unit will be calculated based on FCU air flow and delta T of room temperature and FCU discharge air temp. Fan coil unit air flow will not actually be measured but will be based on design CFM at each of the three specific fan speeds. Readings will be taken every five minutes for each FCU. An excel spreadsheet located on the USC LAN will be updated every twenty four hours with BTU consumption for each dorm room FCU.

vii. DAHUs. Ductless Air Handling Units

3. General:

    a. DAHU units will be controlled by thermostat provided by the equipment manufacturer. Thermostat to be wired by the CCMS contractor. DAHU units will not be connected to the CCMS network.

4. Alarm:

    a. Provide a high temperature alarm to the CCMS.

viii. HRU-1

3. General:

    a. Outside Air Units shall supply neutral temperature air to the building.

    b. Provide supply air discharge sensor for monitoring only.

    c. An electronic programmable DDC controller shall be factory furnished, installed, wired to control the energy recovery system per sequence of operation as specified. Controller shall be Johnson Controls FEC2610 compatible with existing campus BAS. The controller shall be field programmed by JCI. All unit-mounted temperature control devices including sensors, relays, actuators, etc. required to meet the energy recovery unit sequence of operation shall be provided installed and wired by the energy recovery unit manufacturer with the exception of the chilled and hot water control valves and any duct or space mounted sensors. Control valves shall be provided to installing contractor through JCI. The water control valves shall be mounted in field by installing contractor. JCI shall provide control wiring from unit control panel to

control valves as required. Provide all necessary controls required to meet the following sequence of operation.

4. Safeties:

   a. Duct smoke detector will shut the supply fan off whenever products of combustion are sensed. The smoke detector will be provided and wired back to fire alarm system by division 26 and interlocked with the fan starter under division 23.

   b. A temperature low limit switch (freezstat) will de-energize the unit whenever mixed air temperatures drop below 38 degrees to prevent coil freeze.

   c. Whenever unit is shut down on a safety, an alarm will be sent through controller to BAS.

   d. A wheel rotation sensor shall be provided to prove operation of energy recovery wheel. If wheel rotation is stopped while unit is energized, an alarm shall be sent through controller to BAS. Fans shall remain operational.

   e. Dirty filter status contacts will be provided, mounted and wired by unit manufacturer. When contact is made, an alarm shall be sent through controller to BAS. Fans shall remain operational.

5. Start/Stop:

   a. The units will run continuously but will be capable of being started and stopped from the BMS. Unit will controlled by factory supplied, installed and wired controls to meet the following sequence of operation.

   b. When the unit is to be started the outdoor dampers will be driven open. The supply fan will be started once AHU outdoor and exhaust air dampers reach 100% open as indicated by damper end switches. When the unit is stopped the outdoor air damper will not be allowed to close until the supply fan has been allowed to coast down to a complete stop.

   c. Whenever the HRU is started the units associated heat wheel will be enabled to operate. A rotation sensor shall be provided to verify wheel operation. Fans and wheel are constant speed and shall not be modulated.

   d. When the unit is stopped control valves shall modulate to the closed position, supply and exhaust fans shall be de-energized, heat wheel shall be de-energized and supply and exhaust dampers shall be closed.

6. Temperature/Humidity Control:

   a. A unit mounted outside air (entering supply air) sensor shall detect entering air temperature. If temperature is 50 degrees or greater, the units 2-way chilled water valve shall be modulated to maintain discharge air temperature off of the CHW coil of 50 degrees. The heat pipe will operate passively and the hot water coil shall not be energized.

   b. As outside air (entering supply air) temperature is drops from 50 degrees to 45 degrees the HW coil discharge air temperature shall be reset from

50 degrees to 72 degrees. Hot water control valve shall be modulated as necessary to maintain setpoint.

c. All setpoints and setpoint reset schedules shall be adjustable through BAS.

7. Central Control and Monitoring System (CCMS)

a. All sensors and controls shall be factory installed and shall provide the following input/output points to the existing USC Johnson Controls CCMS:

i. Unit status (enabled/ disabled)

ii. Outside (entering) air temperature

iii. Cooling coil discharge air temperature

iv. Unit supply air temperature

v. Entering unit exhaust air temperature

vi. Discharge unit exhaust air temperature

vii. Supply Fan status/ failure

viii. Exhaust Fan status/ failure

ix. Heat wheel status/failure

x. Freezstat alarm

xi. Smoke alarm

xii. Energy recovery wheel status/ failure

xiii. Supply air damper open/ closed

xiv. Exhaust air damper open/ closed

xv. Chilled water valve position

xvi. Hot water valve position

xvii. Dirty filter alarm

ix. PHP-1 Elevator Room Packaged Rooftop Heat Pump

3. Start/Stop:

a. Units will be will run continuous

4. Temperature Control:

a. Units will be controlled by a TEC digital thermostat connected to the network for monitoring of space temperature.

5. Alarm:

a. Provide a high temperature alarm to the CCMS.

x. Radio Room Ductless Heat Pump

3. Start/Stop:

a. Units will be will run continuous

5. Temperature Control:
    a. Unit will be controlled by a thermostat provide by unit manufacturer.
    b. Provide space sensor for monitoring only by the CCMS.
6. Alarm:
    a. Provide a high temperature alarm to the CCMS.

xi. Exhaust Fans:

3. Exhaust fans will be interlocked and controlled as indicated on fan schedule.

End of Section 230900

SECTION 26 01 00

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes lightning protection system modifications and additions to an existing roof and penthouse lighting protection system on the project building.

B. There are existing metallic components on the roof and the penthouse that have not been properly bonded to the existing lightning protection system which shall be properly bonded under this contract. Contractor shall visit project site and inspect existing system and metallic components prior to submitting a bid.

C. There are new metallic components which will be installed on the roof and the penthouse as a part of this project that shall be properly bonded to the existing lightning protection system under this contract. See architectural, structural, mechanical, plumbing, and electrical contract documents for added equipment and components.

1.2 SUBMITTALS

A. Product Data: For air terminals and mounting accessories indicated.

B. Shop Drawings: Detail bonding and connections of all new and existing metallic components installed on the roof and the penthouse to the existing lightning protection system.

C. Qualification data.

D. Certification, signed by Contractor, that roof adhesive for cable attachments is approved by manufacturers of both the cable attachment assembly and the membrane roofing material.

E. Field inspection reports indicating compliance with specified requirements.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is NRTL listed or who is certified by LPI as a Master Installer/Designer.

B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Automatic Lightning Protection.
2. ERICO International Corporation.
3. Harger Lightning Protection, Inc.
4. Heary Bros. Lightning Protection Co. Inc.
5. Robbins Lightning Inc.
6. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protect existing lightning protection system components and conductors during roof renovations. Repair any damages realized during roof replacement at no additional cost to the Owner and in accordance with UL 96A and NFPA 780.

B. Install lightning protection components and systems according to UL 96A and NFPA 780. Bond all new and existing metallic components installed on the roof and penthouse to the existing lighting protection system. Contractor shall visit project site and inspect existing system and metallic components prior to submitting a bid.

C. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above membrane roofing.

D. Cable Fasteners on Membrane Roofing: Comply with adhesive manufacturer's written instructions.

3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. Provide inspections and a final report summary signed by an experienced installer who is NRTL listed or who is certified by LPI as a Master Installer/Designer to certify that the roof and penthouse lightning protection system has be modified and installed in accordance with UL 96A and NFPA 780 for all new and existing exposed metallic components.

END OF SECTION 26 01 00

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Raceways.
2. Building wire and connectors.
3. Electrical identification.
4. Electrical demolition.
5. Cutting and patching for electrical construction.
6. Touchup painting.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70, 2008 Edition.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with existing building construction.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.

C. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

1.6 SUBMITTALS

A. Provide the quantity listed below for each item requiring a submittal.

Record Drawings: 3 sets of 30" x 42" blue- or black-line prints and 1 set of 30" x 42" bond or vellum drawings.

Product Data: 1 original (manufacturer's published/printed cut sheets) and 3 copies of each item. Each set shall be bound in a separate 3-ring binder/notebook with labeled section tabs/dividers.

Operating and Maintenance Manuals: 3 sets, each bound in a 3-ring binder/notebook with labeled section tabs/dividers.

B. RECORD DRAWINGS

Prepare record documents to indicate installed conditions for:

Horizontal and vertical raceway systems; type, size, and location.

Equipment and device locations (exposed and concealed).

Approved substitutions, contract modifications, and actual equipment and materials installed.

C. OPERATING AND MAINTENANCE MANUALS

Prepare maintenance manuals to include the following information for equipment items:

Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature with commercial numbers of replacement parts.

Manufacturer's printed operating procedures to include start-up, routine and normal operating instructions; control, shutdown, and emergency instructions.

Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; and adjusting instructions.

Servicing instructions and schedules.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. EMT: ANSI C80.3, zinc-coated steel, **with compression fittings**.

B. RMC: Zinc-coated steel, with threaded fittings.

C. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

D. Raceway Fittings: Specifically designed for the raceway type with which used.

2.2 CONDUCTORS

A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.

B. Conductors, Larger Than No. 10 AWG: Stranded copper.

C. Insulation: Thermoplastic, rated at 75 deg C minimum.

D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.3 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
2. Color: Black letters on orange background.
3. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).

D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

F. Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.

G. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and lock-washers.

2.4 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to existing raceways and piping systems installed at a required slope.

3.2 RACEWAY APPLICATION

A. Use the following raceways for outdoor installations:
1. Above Ground, Exposed on Building: RMC.
2. Flexible Connection to Equipment: LFMC.
3. Boxes, Gutters and Enclosures: NEMA 250, Type 3R or Type 4.

B. Use the following raceways for indoor installations unless noted otherwise on plan:
1. Dry locations: EMT - Conceal in existing walls and above existing ceilings, unless prior approved by the Engineer.
2. Damp or Wet Locations: RMC.
3. Flexible Connection to Equipment: LFMC.
4. Boxes, Gutters and Enclosures: NEMA 250, Type 1, **except that boxes and enclosures provided in pipe chases shall be NEMA-3R type.**

3.3 RACEWAY AND CABLE INSTALLATION

A. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

B. Use temporary raceway caps to prevent foreign matter from entering.

C. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

D. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

E. Core drill holes in existing masonry walls, floors and ceilings as required to install raceways. Seal openings to prevent entry of moisture. Provide firestopping where applicable (2-hour rated, minimum).

3.4 WIRING METHODS FOR POWER AND CONTROL CIRCUITS

A. Feeders and Branch Circuits: Type THWN insulated conductors in raceway.

B. Control Wires and Cables: Provide wires and cables with conductors and insulation types as recommended by the fire alarm system manufacturer. Conductor sizes, insulation types, and outside diameter of each control wire and cable shall be indicated on required shop drawings. **Conduit fill shall not exceed 40 percent in any case.**

3.5 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.6 IDENTIFICATION OF MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding shall be used.

D. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.
4. Neutral: White.
5. Ground: Green.

E. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

3.7 FIRESTOPPING

A. Apply 2-hour rated firestopping system to cable and raceway for all wall and floor penetrations.

3.8 DEMOLITION

A. Protect existing electrical and mechanical equipment installations. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Remove demolished material from Project site.

D. Remove, store, and clean components indicated for relocation.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved. Coordinate all cutting and patching with the asbestos contractor and the general contractor.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fireproofing has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electrical demolition.
6. Cutting and patching for electrical construction.
7. Touchup painting.

3.11 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.12 CLEANING AND PROTECTION

A. On completion of installation of equipment, raceways, fittings and devices inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 26 05 10

THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations fire-resistance-rated wall assemblies, including openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
3. Fire-resistance-rated floor assemblies.

B. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

C. Provide 2-hour rated firestop systems for all wall, floor, and ceiling raceway penetrations.

1.3 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition encountered, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests shall be performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is **UL.**

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Firestop Systems Inc.
2. Hilti
3. International Protective Coatings Corp.
4. Nelson Firestop Products.
5. 3M Fire Protection Products.
6. Specified Technologies, Inc. (STI)

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

D. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.

2. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Install cable tray pathways in/through existing fire rated walls and smoke barriers as recommended by the pathway system manufacturer.

3.4 FIELD QUALITY CONTROL

A. Proceed with enclosing through-penetration firestop systems with other construction only after Owner inspection is completed.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated

through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. UL-classified systems refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Provide the following 2-hour rated firestop systems for all wall, floor, and ceiling raceway penetrations, as applicable

UL-Classified System	Penetrant	Rating	IPC Product
C-AJ-1235	4" or Smaller EMT Pipe	2 Hour	FS 1900
WL-1152	4" or Smaller EMT Pipe	2 Hour	FS 1900

END OF SECTION 26 05 10

SECTION 26 06 00

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors: Copper or copper alloy, bolted pressure-type, with at least two bolts.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Connections to ground buses: Bolted connectors.

2. Connections for splices: Terminal blocks.

C. Cable Shield Terminations and Connections:

1. Connections for cable splices: Terminal blocks.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

END OF SECTION 26 06 00

SECTION 26 07 20

ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.2 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

1.3 QUALITY ASSURANCE

A. Comply with most stringent seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

1.4 PROJECT CONDITIONS

A. Site Class as Defined in the IBC: See architectural and structural contract documents.

B. S_{ds}: See architectural and structural contract documents.

C. S_{d1}: See architectural and structural contract documents.

D. Assigned Seismic Use Group or Building Category as Defined in the IBC: See architectural and structural contract documents.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Manufacturers:

a. Cooper B-Line; a division of Cooper Industries.
b. ERICO International Corporation.
c. Allied Support Systems; Power-Strut Unit.
d. GS Metals Corp.
e. Michigan Hanger Co., Inc.; O-Strut Div.
f. National Pipe Hanger Corp.
g. Thomas & Betts Corporation.
h. Unistrut; Tyco International, Ltd.
i. Wesanco, Inc.

2. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers:

1) Cooper B-Line; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.
4) ITW Construction Products.
5) MKT Fastening, LLC.
6) Powers Fasteners.

2. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Manufacturers:

a. Amber/Booth Company, Inc.
b. Loos & Co., Inc.
c. Mason Industries, Inc.

2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, unless requirements in this Section or applicable Code are stricter.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated by Code:
   1. To New Concrete: Bolt to concrete inserts.
   2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   3. To Existing Concrete: Expansion anchor fasteners.
   4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, and/or Spring-tension clamps.
   5. To Light Steel: Sheet metal screws.
   6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

B. 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.

C. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

END OF SECTION 26 07 20

SECTION 26 14 20

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

NEC Compliance: Comply with applicable requirements of the 2008 edition of the NEC.

UL Compliance: Comply with UL Std 486A. Provide electrical connection products and materials which are UL-listed and -labeled.

IEEE Compliance: Comply with requirements of Std 241 pertaining to connectors and terminations.

PART 2 - PRODUCTS

General: For each required electrical connection, provide complete assembly of materials, including pressure connectors, terminals (lugs), clamps, electrical insulating tape, heat-shrinkable insulating tubing and boots, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations.

Raceways: Provide metal conduit and tubing complying with Division 26 specification section, "Basic Electrical Materials and Methods".

Wires/Cables: Provide wires, cables and conductors complying with Division 26 specification section, "Basic Electrical Materials and Methods". Unless otherwise indicated, provide wires, cables and conductors for electrical connections which match, including sizes and ratings, wires, cables and conductors of those supplying power to equipment. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

PART 3 - EXECUTION

General: Install electrical connections in accordance with connector manufacturer's written instructions and wiring diagrams, and complying with UL, NEC and NECA's "Standard of Installation".

Where electrical disconnect switches, starters, combination starters and/or variable-speed drive units (VSD's) are furnished by the Mechanical and/or Plumbing Contractor for equipment, the Division 26 contractor shall:

Procure equipment from the Mechanical and/or Plumbing Contractor,

Provide mounting of electrical disconnect switches, starters, combination starters and/or variable-speed drive units, and

Provide power wiring for/through electrical disconnect switches, starters, combination starters and/or variable-speed drive units to equipment.

All control wiring will be provided by the Mechanical Contractor.

Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment, wherever possible.

Cover splices with electrical insulation equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

Trim cables and wires to be short as practicable and arrange routing to facilitate inspection, testing and maintenance.

Provide flexible conduit for motor connections, and for other electrical equipment connections where subject to movement and vibration.

Tighten connectors and terminals, including screws and bolts in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26 section "Basic Electrical Materials and Methods". Affix markers on each terminal conductor, as close as possible to the point of connection.

Test electrical connections to demonstrate capability and compliance with requirements upon completion of installation of connections. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 26 14 20

SECTION 26 44 20

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for distribution panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

D. Maintenance Data: For panelboards and components to include in maintenance manuals.
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with existing building construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.6 EXTRA MATERIALS

A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Panelboards, Overcurrent Protective Devices, and Accessories:

   a. Eaton Corp.; Cutler-Hammer Products
   b. General Electric Co.; Electrical Distribution & Control Division
   c. Square D Company
   d. Siemens

2.2 FABRICATION AND FEATURES

A. Enclosures: Surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
   1. Indoor Locations: NEMA 250, Type 1

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions without overlap.

C. **Hinged Front Cover: Hinged door within front trim cover.**

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: **Hard-drawn copper, 98 percent conductivity.**

G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

H. Equipment Ground Bus (Copper): Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Neutral Bus (Copper): Neutral bus rated 100 percent of phase bus.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.4 DISTRIBUTION PANELBOARDS

A. **Doors: Front mounted, secured with latch and integral tumbler lock; keyed alike (door shall cover all overcurrent devices/circuit breakers).**

B. Main Overcurrent Protective Devices: Circuit breakers.

C. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 200 A and larger. Provide HACR rated circuit breakers where indicated.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting: Plumb and rigid without distortion of box.

C. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

D. Install filler plates in unused spaces.

E. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 44 20

SECTION 26 51 10

LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including driver and/or ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Drivers and Ballasts.
3. Energy-efficiency data.
4. Life, output, and energy-efficiency data for LED's and lamps.
5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with LED's/lamps, drivers/ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Product Certificates: For each type of ballast/ballast for dimmer-controlled fixtures, signed by product manufacturer.

D. Qualification Data: For agencies providing photometric data for lighting fixtures.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, fire detection system, communications system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Drivers and Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts and LED Drivers: Five years from date of Substantial Completion.

B. Special Warranty for T8 Fluorescent and LED Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year from date of Year 2013 Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products described in the Lighting Fixture Schedule on the contract drawings. All manufacturers shall be submitted for prior approval along with electronic IES files.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598.

C. LED Fixtures: Comply with UL 1598.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

H. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 20 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.85 or higher.
7. Power Factor: 0.95 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Ballast Case Temperature: 75 deg C, maximum.
11. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
12. Protection: Class P thermal cutout.

2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted, Edge-Lit Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2. Lettering: Green in color.

2.6 FLUORESCENT LAMPS

A. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

B. T5 rapid-start low-mercury lamps. CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

C. Compact Fluorescent Lamps: Screw-in type with integral ballast, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Electrical Supports and Seismic Restraints" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings:

1. Install a minimum of two ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Basic Electrical Materials and Methods."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 51 10

SECTION 26 72 10

FIRE ALARM SYSTEM

PART 1 - GENERAL

SUMMARY

This Section includes fire alarm systems. It includes requirements for system components including but not limited to the following:

Addressable interface units (AIU's).
Duct type smoke detectors.
Combination remote indicating light and test stations.
CPU firmware and software upgrades.
Addressable loop card addition.
Emergency power supply replacement.
Custom Programming.
Tags.
Riser and branch wiring modifications and additions (additions of box extensions, coverplates and terminal blocks and reworking wiring connections).

DEFINITIONS

Active Multiplex System: A multiplexing system in which signaling devices are employed to transmit and receive status signals of each initiating device and/or initiating device circuit within a prescribed time interval so that lack of receipt of such signal may be interpreted as a trouble signal.

Alarm Initiating Devices: automatic detection devices such as tamper switches and flow switches and associated addressable interface units.

Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals caused by the operation of alarm initiating devices.

Signaling Line Circuit (SLC): Multiplex circuit (Simplex MAPNET) for connection of alarm initiating devices. Circuits shall be electrically supervised such that a single break or a single ground fault condition will be indicated by a trouble signal at the FVCC no matter where the break or ground fault condition occurs.

Supervisory Signal: Indicates need for action regarding maintenance of the fire detection and alarm system.

Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.

Zone: Designation for an initiating device having a unique identity (for means of annunciation, status, and/or control) on a signaling line circuit.

SYSTEM DESCRIPTION

SYSTEM DESCRIPTION

General: The existing fire alarm system in South Tower is a **Simplex #4100 Series** fire and voice command center (FVCC). The existing fire detection and voice evacuation portions of the system shall remain in place and shall be modified and expanded as indicated herein.

Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.

Audible Alarm Indication: By digital voice alarm messages and tone signals on existing loudspeakers for general fire alarm. **In addition to fire alarm notification, an audible input shall be provided in the FVCC to connect the Universities Mass Notification system for audible alert messages. Signal and connectivity requirements shall be coordinated with Todd Griffin (USC Fire Marshal).**

System connections for alarm initiating devices: Addressable type devices shall be connected using signaling line circuits (multiplex addressable type - MAPNET).

Alarm initiation for installed fire detection devices shall be as follows:

Kitchen hood fire suppression activation shall initiate a general alarm and shall automatically disconnect 208-volt power to associated range receptacle circuit.

Duct type smoke detector shall initiate a supervisory alarm and shutdown power to its associated air handling unit fan motor(s).

Existing Function Switch at FVCC Panel: Provide custom programming for one existing pushbutton on the FVCC panel that will control all duct smoke detectors in the building such that when the button is pressed, all air handling unit fans in the building will be shut down. Pressing the button a second time shall cause all air handling units to automatically restart (unless a unit's duct detector is in alarm).

Independent System Monitoring: Supervise each detection device and each alarm notification device for both normal operation and trouble.

Circuit Supervision: Indicate circuit faults with both a zone and a trouble signal at the FVCC.

SUBMITTALS

General: Submit the following:

Product Data: Submit product data for all fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials.

Wiring Diagrams: Submit wiring diagrams from the manufacturer differentiating between manufacturer-installed and field-installed wiring. Include diagrams for equipment wiring and for system wiring with all terminals and interconnections identified. Include drawings indicating components for both field and factory panel wiring.

Shop Drawings: Submit shop drawings from the manufacturer indicating all horizontal and vertical building wiring for detection, alarm, and communications circuits. Include equipment types and locations, raceway sizes, number and type of wires/cables, and conductor color coding for each circuit type. Shop drawings shall be provided on 30" x 42" (E-size) prints.

System Operation Description: Submit system operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project. Manufacturer's standard descriptions for generic systems are not acceptable.

Operation and Maintenance Data: Submit operation and maintenance data that shall be included in an operating and maintenance manual. Operation and maintenance data shall cover each type of product, including all features and operating sequences, both automatic and manual. In addition, provide the following:

1. Spare parts data.
2. Names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the systems to be furnished.
3. A listing of the manufacturer's representatives responsible for installation coordination and service.
4. A list of CPU addresses for every device that is provided for purposes of alarm initiation, status monitoring, and auxiliary control.

Product certification: Submit a product certification letter signed by the manufacturer of the fire alarm system components certifying that their products comply with the referenced standards.

QUALITY ASSURANCE

Compliance With Local Requirements: Comply with the International Building Code (IBC), local ordinances, requirements of the USC Fire Marshal, and requirements of the State Engineer (the authority having jurisdiction). Work performed by the Installer shall not void or in any way affect current warranties on Owner's existing fire alarm equipment.

NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:

NFPA 70, "National Electrical Code."

NFPA 72, "National Fire Alarm Code."

UL Listing and Labeling: Provide system and components specified in this Section that are listed and labeled by UL.

Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components furnished.

WARRANTY SERVICE

Warranty Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months commencing with Substantial Completion, using factory-authorized service representatives.

Basic Services: Systematic, routine maintenance visits on a monthly basis at times coordinated with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

SPARE PARTS

Addressable Interface Unit: Furnish two – monitor type.

PART 2 - PRODUCTS

General: All fire alarm system components shall be manufactured by Simplex Time Recorder Company unless noted otherwise.

BACKBOXES FOR FIRE ALARM SYSTEM DEVICES

Flush Type Backboxes for use in Indoor Conditioned Spaces:

Outlet and Device Backboxes: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application. Provide "old-work" type boxes where required for proper mounting in existing walls and ceilings.

Surface Type Backboxes for use in Indoor and Outdoor Non-Conditioned Spaces:

Weatherproof type backboxes shall be provided for all devices located in non-conditioned spaces. Provide cast-metal boxes with threaded conduit hubs and neoprene gaskets (Crouse-Hinds, Appleton, or equal). Drill two 1/8" weep holes in the bottom side of each box to allow water drainage. Provide weatherproof boxes that are manufactured by the fire alarm device manufacturer where available. Provide plugs in all unused conduit hubs.

ADDRESSABLE INTERFACE UNITS (AIU's)

General: Provide monitor type addressable interface units that are compatible with the existing Simplex #4020 FACP for connection of new sprinkler system tamper and flow switches.

Provide a weatherproof cast metal box with cover and gasket for units located in non-conditioned spaces.

Provide a NEMA 1 box with cover for units located in conditioned spaces.

DUCT TYPE SMOKE DETECTORS

General: Comply with UL 268, "Smoke Detectors for Fire Protective Signalling Systems." Detectors shall be analog type and shall be provided with the following features:

Factory Nameplate: With serial number and type identification.

Operating Voltage: 24-V d.c., nominal.

Self-Restoring: Provide detectors that do not require resetting or readjustment after actuation to restore them to normal operation.

Plug-in Arrangement: Detector and associated encapsulated electronic components mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection shall require no springs for secure mounting and contact maintenance. Provide terminals in the fixed base for building wiring.

Visible Indicator: LED type connected to indicate detector has operated.

Analog Function: Transmit signals to indicate when a detector is dirty and requires cleaning or when it has drifted outside of its listed sensitivity range.

Addressability: Provide detectors with a communication transmitter and receiver having a unique identification and status reporting capability to the FVCC.

Duct Smoke Detectors: Include the following features and characteristics:

Smoke detector with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Complete with housing and programmable relay as required for fan shutdown. Housings shall be of types that are surface mounted to the exterior of ducts to allow immediate access to the smoke detector; housings manufactured to be installed within ducts shall not be provided.

Sensor: Photoelectric type with infrared detector light source and matching silicon cell receiver.

Detector Sensitivity: Adjustable between 0.6 and 3.7 percent per foot smoke obscuration when tested in accordance with UL 268. **Programmed/Installed setpoint for each detector shall be 3.7% per foot.**

Remote Controllability: Provide detectors individually monitorable at the FVCC for calibration, sensitivity, and alarm condition, and have capability of individually adjusting sensitivity from the FVCC. Detector units shall also shutdown air handling units via manual operation of control switch at the FVCC and remote annunciator panel.

Programmable Relay: Each detector shall be provided with an integral programmable control relay that shall be rated to properly interface with the HVAC control system for shutdown functions. **Provide an isolation relay of proper ratings if the detector relay ratings do not meet HVAC system control voltage and amperage requirements.**

Weatherproof (WP) Detectors: Provide a UL Listed weatherproof detector/housing arrangement, suitable for installation on exterior, roof-mounted ductwork.

COMBINATION REMOTE INDICATING LIGHT AND TEST STATIONS

General: Provide stations including a location-indicating, system-voltage light and a keyed test switch for remote status and testing of smoke detectors. Station components shall be attached to a wallplate for mounting on a single-gang wall or ceiling box, as applicable. Provide two keys to the Owner for each unit provided.

Weatherproof (WP) Stations: Provide weatherproof rated test stations with cast metal, gasketed backbox and STI Mini-Stopper cover where stations are indicated to be weatherproof.

EXISTING FIRE AND VOICE COMMAND CENTER (FVCC)

General: Comply with UL 864, "Control Units for Fire Protective Signaling Systems."

Software Upgrade: Provide a software and firmware upgrade for the existing FVCC to the latest edition currently available from the manufacturer (Simplex).

Mass Notification Messages: Provide a third audio input channel in the FVCC to output Mass Notification messages over the voice alarm system speakers. Coordinate signal input and connectivity requirements with Todd Griffin (USC Fire Marshal). Provide custom programming and testing to ensure proper operation.

Addressable Loop Card: Provide one addressable loop card in the existing Simplex #4100 FVCC for connection of addressable interface units and of duct type smoke detectors.

Emergency Power Supply: Provide a new emergency power supply for the FVCC. Replacement components shall include batteries, charger, an automatic transfer switch, and a separate/remote mounting enclosure that match or exceed ratings of existing components.

TAGS

Tags For Identifying Tested Components: Comply with NFPA 72.

PART 3 - EXECUTION

INSTALLATION, GENERAL

Install system in accordance with Codes and Standards referenced in Parts 1 and 2 of this Section.

EQUIPMENT INSTALLATION

Existing Fire Alarm Equipment: Maintain fully operational until the new equipment has been tested and accepted. As new equipment is installed, labeled it "NOT IN SERVICE" until the new equipment is accepted. Remove tags from new equipment when put into service and tag existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

Custom Programming: Make all programming and hardware/firmware modifications necessary to update the existing fire alarm equipment in South Tower as required to accommodate system additions and modifications.

Addressable Loop Card and **Low-Voltage Power Supply (if required to support new devices)**: Install components in the existing FVCC cabinets and provide all associated line-voltage, low-voltage, and communications wiring/cabling.

Addressable Interface Units: Provide a cast metal box with gasket and cover for units located in non-conditioned spaces. Install units in a NEMA 1 enclosure in conditioned locations.

Duct Smoke Detectors: Mount units in duct work as recommended by the manufacturer and in accordance with NFPA 72 and 90A. Provide all electrical power and control circuits as required to shutdown air handlers and any

associated duct heaters. Coordinate circuit ratings and wiring connections at air handling units with the mechanical contractor. All wiring shall be provided in EMT raceway.

Combination Remote Indicating Light and Test Stations:

Ceiling Mounted: Mount stations in a single-gang, recessed box for stations indicated to be ceiling mounted. Mount station in ceiling as close in proximity to the detector as practical.

Wall Mounted: Mount stations in a single-gang, surface raceway type wall box at 48 inches above finished floor. Outdoor stations shall be weather proof as described above.

WIRING AND RACEWAY INSTALLATION, ADDITIONS, AND MODIFICATIONS

General: Provide raceway and wiring to all equipment and devices indicated on the contract drawings. The contract drawings indicate partial raceway and wiring requirements to help clarify design intent. Where raceway and wiring are not indicated on the drawings for devices or equipment, the arrangement, grouping, and routing of raceway and wiring shall be provided by the contractor in accordance with the National Electrical Code, NFPA 72, and in accordance with methods outlined in the contract specifications and drawings.

Wiring: Provide wiring in accordance with Division 26 specification section "Basic Electrical Material and Methods" and as recommended by the fire alarm system manufacturer (Simplex). Install riser cables of types that comply with NFPA 70 and NFPA 72.

Raceways: Install all wiring in metal raceway in accordance with Division 26 specification section "Basic Electrical Material and Methods".

Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors associated with the fire alarm system that are terminated, spliced, or interrupted to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors. Solder and/or wire nuts shall not be used.

Cable Taps and Splices: Cable taps and splices shall be kept to a minimum. **Provide numbered terminal strips in junction boxes, pull boxes, outlet boxes, cabinets, and equipment enclosures where any tap or splice is made. Solder and/or wire nuts shall not be used.**

Existing Riser Junction Boxes: Provide numbered terminal strips in existing riser junction boxes and rework all connections/splices to the terminal strips. All wire nuts shall be removed.

Existing Branch Junction Boxes Located Above Ceilings on Floors 1 through 18 and the Basement Level: Provide box extensions and red coverplates over all existing branch junction boxes that serve fire alarm devices on each floor. Remove wire nuts and provide terminal blocks in existing junction boxes and rework all connections/splices to the terminal strips.

Color Coding: Color code all fire alarm conductors differently from the normal building power wiring. Match color code of existing signaling line circuits. Paint fire alarm system junction boxes and covers red.

GROUNDING

Ground equipment conductors and cable shields. **Cable shields shall be spliced on terminal blocks (not twisted/wrapped together).**

FIELD QUALITY CONTROL

Manufacturer's Field Services: Provide services of a Simplex factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system, and to perform system programming. **Note that testing of the fire alarm system shall be performed for Phase A (Year 2012) construction and for Phase B (Year 2013) construction.**

Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. **Prepare forms for systematic recording of acceptance test results.**

Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable. The letter shall include the names and titles of the witnesses to the preliminary tests.

Final Test Notice: Provide 10 days' minimum notice in writing when the system is ready for final acceptance testing.

Minimum System Tests: Test the system in accordance with the procedures outlined in NFPA 72. Minimum required tests are as follows:

Verify the absence of unwanted voltages between circuit conductors and ground.

Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Proper signal transmission in accordance with class of wiring used shall be observed.

Test each initiating and indicating device for alarm operating and proper response at the control unit. Test smoke detectors with actual products of combustion.

Test the system for all specified functions in accordance with the manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.

Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner required per NFPA 72.

Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

Report of Tests and Inspections: **Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.**

COMMISSIONING

Provide the services of a Simplex factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours' training.

Schedule training with the Owner in writing at least seven days in advance.

Occupancy Adjustments: When requested within one year of date of Substantial Completion **(note there are two)**, provide on-site assistance in adjusting detector sensitivity setpoints and controls to suit actual occupied conditions. **Provide two 8-hour visits to the site for this purpose for Phase A completion and two 8-hour visits to the site for Phase B completion.**

END OF SECTION 26 72 10