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Addendum No. 1

INNOVATION DRIVE WELL

PWP Bid No. WA-2016-040

October 29, 2015

The following information, clarifications, changes and modifications are by reference incorporated into the bid documents for the above referenced project. Any work item or contract provision not changed or modified will remain in full force and effect. The bid date and time and construction schedule remain the same.

CLARIFICATION

The HVAC specifications (15500 – 15950) were inadvertently omitted from the Technical Specifications. They are attached to Addendum No. 1. Please insert and include the HVAC specifications in the appropriate section of the Technical Specifications. Thank you!

Innovation Drive Well
Truckee Meadows Water Authority

Bid Set
August 2015

HVAC Technical Specifications Table of Contents

SECTION 15500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 General Requirements:

A. Provide all necessary labor, materials, equipment, services and insurances to complete the heating, ventilating and air conditioning work within the full intent of the drawings and specifications contained hereon and to the entire satisfaction of the architect/engineer.

B. Provide all permits and fees as required for the mechanical work.

C. Contractor shall visit the site and become familiar with the project before bidding.

D. All work shall be in accordance with the 2012 International Building Code (IBC), 2009 International Energy Conservation Code (IECC), 2012 International Fire Code (IFC), 2012 Uniform Mechanical Code (UMC), 2012 Uniform Plumbing Code (UPC), 2011 National Electrical Code (NEC), National Fire Protection Association (NFPA) standards, and all other applicable codes, rules, and local requirements.

E. Guarantee all work and materials for a period of one year.

F. All dimensions and measurements shall be verified at the jobsite before fabrication and/or installation of the equipment.

G. Provide and install all equipment, duct, piping, and controls as shown on the drawings.

1.2 Summary

A. This Section includes the following:

1. Equipment installation requirements common to equipment sections.
2. Supports and anchorages.

B. Provide all necessary labor, materials, equipment, services and insurances to complete the heating, ventilating and air conditioning work within the full intent of the drawings and specifications contained hereon and to the entire satisfaction of the engineer.

C. All dimensions and measurements shall be verified by the contractor at the jobsite before fabrication and/or installation of the equipment.

1.3 Definitions

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

1.4 Submittals

A. Furnish six (6) sets of submittals (bound with cover) of manufacturer's data sheets for all materials and equipment for approval of the architect/engineer prior to purchase and installation. Incomplete submittals will not be reviewed.

B. Electronic submittals in adobe pdf format, in lieu of paper copies, will only be accepted if prior written authorization is granted by the owner, architect, and general contractor.

C. Substituted items shall be submitted with manufacturer's descriptive data and must show equality to equipment specified. Information on substituted items must be complete, including, but not limited to: design, construction materials, construction quality, and sound levels. Engineer will not research information required to compare equipment. Engineer reserves the right to require specified equipment.

D. Submit manufacturer's descriptive data within ten (10) working days after award of the contract. Materials and equipment shall not be ordered prior to submittal approval. Allow ten (10) working days after receipt of submittals in the engineer's office before reviewed submittals will be returned.

E. Upon completion of the project, and prior to final acceptance payment, submit one (1) set of as-built drawings and three sets of operating and maintenance instructions (bound in 3-ring binders).

1.5 Workmanship

A. All work to be performed by qualified personnel normally engaged in the respective line of work.

B. Perform all work in a manner not to disturb the normal operation of the building.

C. Coordinate all work with the owner's representative.

D. The contractor is responsible for performing all work acceptable to the owner's representative.

1.6 Seismic Restraints

A. All equipment, ductwork, piping, and conduit shall be seismically restrained per the 2012 IBC.

B. References: international building code (IBC) section 1613.1, American Society of Civil Engineers (ASCE 7) section 13.6, Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) seismic restraint manual, and American Society of Plumbing Engineers (ASPE) plumbing engineers design handbook.

1.7 Project/Site Conditions

A. Examine the site, verify dimensions and locations against the drawings, and inform self of conditions under which work is to be done before submitting bid. No allowance will be made for extra expense on account of error by contractor.

B. Information shown relative to existing locations is based upon available records and data but shall be regarded as approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost.

C. Install work in locations shown on drawings, unless prevented by project conditions or directed otherwise by TMWA representative.

D. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Owner/Engineer before proceeding.

1.8 Quality Assurance

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished, provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.9 Final Inspection

A. Prior to final acceptance of the HVAC equipment and controls, a satisfactory start-up and functional testing shall be conducted by the contractor and witnessed by the HVAC engineer.

PART 2 - PRODUCTS

2.1 Pipe, Tube, And Fittings

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 Joining Materials

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12.

2.3 Escutcheons

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.4 Grout

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 Product Handling

A. Protection: use all means necessary to protect the materials of this section before, during, and after installation and to protect the materials and work of the other trades.

B. Replacements: in the event of damage, immediately make all repairs and replacements necessary to the approval of the engineer and at no additional cost to the owner.

3.2 Piping Systems - Common Requirements

A. Install piping according to the following requirements, Division 15 HVAC section specifying piping systems, and drawings.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install escutcheons for penetrations of walls, ceilings, and floors.

L. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using Sikaflex Construction Sealant.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 Piping Joint Construction

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

G. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

H. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 Piping Connections

A. Make connections according to the following, unless otherwise indicated:

B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

C. Install dielectric coupling fittings to connect piping materials of dissimilar metals.

3.5 Equipment Installation - Common Requirements

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 Erection Of Metal Supports And Anchorages

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

END OF SECTION

Section 15520

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 Summary

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 Submittals

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

B. Shop Drawings: Provide list of wording, symbols, letter size, and color coding for mechanical identification and a valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.3 References

A. ASME A13.1 (American Society of Mechanical Engineers) - Scheme for the Identification of Piping Systems.

B. Conform to OSHA requirements for color scheme for identification of all piping systems.

PART 2 - PRODUCTS

2.1 Equipment Labels

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Conform to ASME A13.1.
3. Background Color: Conform to ASME A13.1.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing

numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 Warning Signs And Labels

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Conform to ASME A13.1.

C. Background Color: Conform to ASME A13.1.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 Pipe Labels

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Letter Color: Conform to ASME A13.1.

C. Background Color: Conform to ASME A13.1.

D. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 Preparation

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 Equipment Label Installation

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 Pipe Label Installation

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 40 feet along each run. Reduce intervals to 20 feet in areas of congested piping and equipment.

END OF SECTION

Section 15550

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 Summary

A. This Section includes the following:

1. Steel pipe hangers and supports.
2. Metal framing systems.
3. Fastener systems.
4. Equipment supports.

1.2 Performance Requirements

A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 Submittals

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Powder-actuated fastener systems.

PART 2 - PRODUCTS

2.1 Manufacturers

A. In other Part 2 articles within this section where titles below introduce lists, the following requirements apply to product selection:

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

2.2 Steel Pipe Hangers And Supports

A. Description: 12 gauge steel, galvanized, 1-5/8" x 1-5/8" strut channel (B-Line #B-22 or equal) with insulated pipe clamps (B-Line BVT series).

B. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.3 Fastener Systems

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Manufacturers:

1. B-Line Systems, Inc.
2. Hilti, Inc.

2.4 Equipment Supports

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.5 Miscellaneous Materials

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 Hanger And Support Applications

A. Install strut and pipe clamp for copper tubing.

B. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 Hanger And Support Installation

A. Steel Pipe Hanger Installation: Install supports, clamps, and attachments as required to properly support piping from building structure.

B. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Use mechanical-expansion anchors, threaded couplings, threaded rod, washers, nuts, and strut as required to properly support equipment from building structure.

3.3 Equipment Supports

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 Metal Fabrications

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 Adjusting

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 Painting

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

Section 15600

HVAC PIPING, VALVES, FITTINGS, AND SPECIALTIES

PART 1 - GENERAL

1.1 Summary

A. Section Includes:

1. Aboveground water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Escutcheons.
4. Flow regulating valves.
5. Water pressure-reducing valves.
6. Strainers.
7. Flow control actuator valves.
8. Ball valves.
9. Backflow preventer

1.2 Performance Requirements

A. Minimum Working Pressure for Water Piping Specialties: 150 psig unless otherwise indicated.

1.3 Submittals

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

B. Operation and maintenance data.

1.4 Quality Assurance

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 General

A. Pressure/temperature test ports must be accessible for testing (facing center of vault). Supplier to verify port orientation with drawings. Contractor to field verify port orientation before installation. Flow regulating valves installed with ports facing the wall will not be accepted.

2.2 Above-Grade Copper Tube And Fittings

A. NPS 2” and smaller: Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.

1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube.

1. Brass single flare fittings

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.3 Below-Grade Copper Tube

A. NPS 2" and smaller: Soft Copper Tube: ASTM B 88, Type K water tube, annealed.

B. Fittings shall not be allowed below-grade. Tube is to be bent per UPC tube bending guide.

C. Below-grade copper tube shall be wrapped with 20 mil thick PVC plastic tape installed in accordance with manufacturer's instructions.

2.4 Transition Fittings

A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Sleeve-Type Transition Coupling: AWWA C219.

2.5 Dielectric Fittings

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

A. Insulating Material: Suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

C. Manufacturer: Hart series class 3000 (or equal)

2.6 Escutcheons

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Stamped Steel: Chrome-plated finish with setscrew.

C. Split Plate, Stamped Steel: Chrome-plated finish with exposed-rivet hinge, setscrew.

2.7 Flow Regulating Valves

A. Automatic Flow Regulating Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hays Fluid Controls.
   b. Approved equal.

2. Operation: Pressure-independent applications.
3. Body: Brass for NPS 2 and smaller.
4. End Connections: Threaded for NPS 2 and smaller.
5. Configuration: Designed for horizontal, straight through flow.

2.8 Water Pressure-Reducing Valves

A. Water Regulators:

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

b. Zurn.

2. Standard: ASSE 1003.
3. Pressure Rating: Working pressure of 150 psig.
4. Design Inlet Pressure: 100 psig.
5. Design Outlet Pressure Setting: see plans.
6. Body: Lead-free Bronze for NPS 2 and smaller.
7. End Connections: Threaded for NPS 2 and smaller.
8. Pressure gage: 0-160 psi dial face gauge

2.9 Strainers

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.
   b. Approved equal.

2. Pressure Rating: 125 psig minimum, unless otherwise indicated.
3. Body: Lead-free Bronze for NPS 2 and smaller.
4. End Connections: Threaded for NPS 2 and smaller.
5. Screen: Stainless steel with round perforations, unless otherwise indicated.
6. Perforation Size: Strainers NPS 2 and Smaller: 0.020 inch.
7. Drain: Hose-end drain valve.

2.10 Flow Control Actuated Valves

A. Ball-Valve-Type, motorized valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Belimo.
   b. Approved equal.

2. Pressure Rating: Rating: 150-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Stainless Steel.
5. Ball: Stainless Steel.
6. Stem: Stainless Steel
7. Seats and Seals: Replaceable.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded or solder joint.
10. Actuator: spring return.

2.11 Bronze Ball Valves

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane.
   b. NIBCO INC.
   c. Red-White Valve Corporation.
   d. Watts.

2. Description:
   e. Standard: MSS SP-110.
   f. SWP Rating: 150 psig

g. CWP Rating: 600 psig
h. Valve Sizes: Same as upstream piping unless otherwise indicated.
i. Body Design: Two piece.
j. Body Material: Lead-free Bronze.
k. Ends: Threaded.
l. Seats: PTFE or TFE.
m. Stem: Bronze.
n. Ball: Chrome-plated brass.
o. Port: Full.
p. Handle: Lever, quarter turn

2.12 Reduced-Pressure-Principle Backflow Preventers

A. Standard: ASSE 1013.

B. Operation: Continuous-pressure applications.

C. Pressure Loss: 12 psig maximum, through middle third of flow range.

D. Body: Bronze for NPS 2 and smaller

E. End Connections: Threaded for NPS 2 and smaller

F. Configuration: Designed for horizontal, straight-through flow.

G. Accessories:

1. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
2. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

PART 3 - EXECUTION

3.1 Piping Installation

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install water-pressure-reducing valves downstream from shutoff valves.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping adjacent to equipment and specialties to allow service and maintenance.

F. Install piping to permit valve servicing.

G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 Joint Construction

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 Transition Fitting Installation

A. Install transition couplings at joints of dissimilar piping.

3.4 Dielectric Fitting Installation

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5 Hanger And Support Installation

A. Comply with requirements in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   b. NPS 3/4 and Smaller: 60 inches.

B. Install supports for vertical copper tubing every 10 feet.

3.6 Escutcheon Installation

A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.7 Flow Regulating Valve Installation

A. Install flow regulating valve with test ports facing the room interior.

3.8 Water Regulator Installation

A. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

3.9 Strainer Installation

A. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

3.10 Flow Control Actuated Valves

A. Install dielectric unions at both inlet and outlet of stainless steel flow control actuated valves.

3.11 Valve Installation

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.12 Field Quality Control

A. Piping Tests:

1. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

3.13 Cleaning

A. Clean water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Flush piping system with clean, potable water until dirty water does not appear at outlets.

B. Clean interior of water piping system. Remove dirt and debris as work progresses.

3.14 Piping Schedule

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Aboveground water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and soldered joints.

C. Instrumentation piping shall be the following:

1. Soft copper tube, ASTM B 88, Type K; flare ends, brass fittings.

D. Instrumentation piping below-grade shall be enclosed in the following:

1. Schedule 80 PVC conduit tested in accordance to UL-651 and 514. Piping sleeve shall be supported by sand backfill bedding in bottom of trench.
2. Elbows shall be long sweep with a 36” radius.

END OF SECTION

Section 15650

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.4 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: Type ACR (Minimum 1/32” wall thickness).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. See Evaluations for discussions of solder and brazing materials.

E. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

F. Brazing Filler Metals: AWS A5.8.

2.2 REFRIGERANTS

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

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

1. Atofina Chemicals, Inc.
2. DuPont Company.
3. Honeywell, Inc.
4. INEOS Fluor Americas LLC.

C. R410A.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Liquid Lines and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. PVC pipe sleeves shall be used for underground installation of refrigerant piping as shown on the drawings. PVC piping and fittings shall meet the following requirements:

1. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
2. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
3. Adhesive Primer: ASTM F 656.
4. Solvent Cement: ASTM D 2564.

C. Install refrigerant piping according to ASHRAE 15.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping adjacent to machines to allow service and maintenance.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

3.3 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."

B. Install the following pipe attachments:

1. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 REFRIGERANT SYSTEM PRESSURE TESTING, EVACUATION, AND CHARGING

A. Refrigerant system pressure testing, evacuation, and charging procedures shall be performed in the presence of the Owner's Representative and/or the Engineer after the refrigerant piping system installation is complete.

B. Prior to evacuation and charging, the refrigerant system shall be pressure tested with nitrogen per the equipment manufacturer’s written recommendations for test pressure(s). Pressure testing shall be conducted when the ambient temperature is relatively stable and shall hold for a minimum of 4 hours without a drop in pressure.

C. Utilize properly sized vacuum pump(s) for refrigerant system evacuation. The refrigerant system compressor shall not be utilized to evacuate the system, nor operated at any time prior to completing the specified triple evacuation procedure. Conduct evacuation and charging procedures at ambient temperatures of 60oF or above. If ambient temperatures are consistently below 60oF, contact the Owner and/or the Engineer immediately for an alternative procedure or alternative scheduling.

D. The first evacuation shall be to 1,000 microns, holding at 1,000 microns for a minimum of two hours. Break the vacuum with either nitrogen or refrigerant.

E. The second evacuation shall be to 750 microns, holding at 750 microns for a minimum of two hours. Break the vacuum with either nitrogen or refrigerant.

F. The third evacuation shall be to 500 microns, holding at 500 microns for a minimum of two hours. Break the vacuum with either nitrogen or refrigerant.

G. After testing, fully charge each system with refrigerant and then conduct a leak test of the entire system with an electronic leak detector.

3.7 ADJUSTING

A.

B. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

C. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

D. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

E. Perform adjustments before operating the refrigeration system, according to manufacturer's written instructions

END OF SECTION

Section 15700

HVAC DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 Summary

A. Section Includes:

1. Ductwork
   a. Rectangular ducts and fittings.
   b. Sheet metal materials.
   c. Sealants and gaskets.
   d. Hangers and supports.

2. Duct Accessories
   a. Flexible connectors
   b. Duct accessory hardware.
   c. Fixed, extruded aluminum louvers
   d. Combination, extruded aluminum louver/dampers
   e. Round control dampers

B. Related Sections:

1. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.2 Performance Requirements

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 Submittals

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

B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 Rectangular Ducts And Fittings

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 Sheet Metal Materials

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: 60 (Z180).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.3 Sealant And Gaskets

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.4 Hangers And Supports

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.5 Fixed, Extruded Aluminum Louvers

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

1. Greenheck.
2. Nailor.
3. United Enertech.

B. Louver Depth: 4 inches

C. Frame: 0.125 inch thick extruded aluminum

D. Blades: 0.125 inch thick extruded aluminum

E. Point of Beginning Water Penetration: Not less than 700 feet per minute

F. Finish: Kynar. Color selection by owner. Provide color selection chart with equipment submittal.

2.6 Combination Extruded Aluminum Louver/Dampers

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

1. Greenheck.
2. Nailor.
3. United Enertech.

B. Depth: 4 inches

C. Frame: 0.125 inch thick extruded aluminum

D. Blades: 0.081 inch thick extruded aluminum with jamb seals

E. Axles: Steel with synthetic bearings

F. 120V spring-return damper actuator

G. Point of Beginning Water Penetration: Not less than 700 feet per minute

2.7 Round Control Dampers

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

1. Greenheck.
2. Nailor.
3. United Enertech.

B. Frame: Galvanized steel

C. Blades: Galvanized steel with silicone seal

D. Axles: Steel with bronze bearings

E. 120V spring-return damper actuator

F. Leakage: Not to exceed 4 CFM/SF at 1" w.c.

2.8 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.

2. Duro Dyne Inc.
3. Hardcast, Inc.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.

H. Materials: Flame-retardant or noncombustible fabrics.

I. Coatings and Adhesives: Comply with UL 181, Class 1.

J. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-de, 0.028-inch-ick, galvanized sheet steel or 0.032-inch-ick aluminum sheets. Provide metal compatible with connected ducts.

K. Connector fabric in "Indoor System, Flexible Connector Fabric" Paragraph below is not suitable for exposure to sun, weather, or corrosive environments. It is suitable for system temperatures from minus 10 to plus 200 deg F (minus 23 to plus 93 deg C).

L. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F

M. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F

PART 3 - EXECUTION

3.1 Duct Installation

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 Installation Of Exposed Ductwork

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 Duct Sealing

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 Hanger And Support Installation

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 Connections

A. Make connections to equipment with flexible connectors complying with this section.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 Start Up

A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing."

3.7 Duct Schedule

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fans:
   a. Pressure Class: Positive 1-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.

END OF SECTION

Section 15850

SPLIT-SYSTEM AIR-CONDITIONING UNIT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Operation and maintenance data.

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. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

E. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

F. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within one year from date of Substantial Completion.

B. The compressor shall have a warranty of 6 years from date of substantial completion. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Daikin
2. Mitsubishi.
3. Samsung.
4. LG.

2.2 EVAPORATOR-FAN UNIT

A. Unit Cabinet:

1. The indoor unit cabinet shall be wall mounted by means of a factory supplied mounting plate. The cabinet shall be formed from high strength molded plastic with front panel access for filter. Cabinet color shall be white. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be al factory wiring and internal piping, control circuit board and fan motor.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve. A condensate pan and drain shall be provided under the coil.

B. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

C. Fan Motor: Multispeed.

D. Filters: 1 inch thick, in fiberboard frames with ASHRAE 52.2 MERV rating of 6 or higher.

2.3 AIR-COOLED, COMPRESSOR HEAT PUMP UNIT

A. Casing: galvanized steel, finished with powder coating, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, contactor, manual-reset high-pressure switch, and automatic-reset low-pressure switch.

C. Refrigerant: R-410A.

D. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

E. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

F. Fan: Propeller type, directly connected to motor.

G. Motor: Permanently lubricated, with integral thermal-overload protection.

H. Mounting Base: Polyethylene.

I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 CONTROLS

A. Thermostat: Low voltage with sub-base to control compressor and evaporator fan. Thermostat wire shall be installed in rigid conduit from the evaporator coil to the thermostat location.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

B. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base; 4 inches larger on each side than unit.

3.2 CONNECTIONS

A. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

Section 15870

HVAC FANS

PART 1 - GENERAL

1.1 Summary

A. This Section includes In-line centrifugal fans and accessories.

1.2 Submittals

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

B. Operation and maintenance data.

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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. UL Standard: Power ventilators shall be UL 705 listed and labeled.

PART 2 - PRODUCTS

2.1 In-Line Ventilators:

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

1. Greenheck.
2. Loren Cook Company.
3. PennBarry.

B. Description: Centrifugal fans designed for in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

2.2 Propeller Fans:

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

1. Greenheck.
2. Loren Cook Company.
3. PennBarry.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

C. Fan Wheel: Replaceable, fabricated aluminum blades fastened to steel hub; factory set pitch angle of blades.

D. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Drive:

1. Resiliently mounted to housing.
2. Statically and dynamically balanced.
3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
4. Extend grease fitting to accessible location outside of unit.
5. Service Factor Based on Fan Motor Size: 1.4.
6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.

F. Accessories:

1. Accessories listed in subparagraphs below are optional features.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

PART 3 - EXECUTION

3.1 Installation

G. Install power ventilators level and plumb.

H. Ceiling Units: Suspend units from structure.

I. Install units with clearances for service and maintenance.

J. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Ductwork and Accessories."

K. Motor: Provide EC motor with mounted and wired disconnect switch. EC motor shall have speed control dial.

L. Install ducts adjacent to power ventilators to allow service and maintenance.

M. Ground equipment according to Division 16.

N. Connect wiring according to Division 16.

3.2 Field Quality Control

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Verify lubrication for bearings and other moving parts.

5. Energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
6. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

Section 15880

HVAC WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 Summary

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils

1.2 Submittals

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

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 Wall and Ceiling Unit Heaters

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

1. QMARK
2. Or Approved Equal

B. Description: wall and ceiling heaters with propeller fans and electric-resistance heating coils.

C. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Housing: Die-formed Steel

F. Electric-Resistance Heating Coil: Aluminum-finned, copper clad steel sheath heating element, free from expansion noise and 60-Hz hum.

G. Electrical Requirements: NEMA 6-30P plug and cord for electrical to wall receptacle.

PART 3 - EXECUTION

3.1 Installation

A. Install heaters level and plumb.

B. Wall Units: Secure units to wall.

C. Install units with clearances for service and maintenance.

D. Install ducts adjacent to heaters to allow service and maintenance.

E. Ground equipment according to Division 16.

F. Connect wiring according to Division 16.

3.2 Field Quality Control

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Verify lubrication for bearings and other moving parts.
5. Energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
6. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

Section 15950

HVAC TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 Summary

A. Section Includes:

1. Balancing Air Systems of constant-volume air systems.

1.2 Definitions

A. AABC: Associated Air Balance Council.

B. TAB: Testing, adjusting, and balancing.

C. TAB Specialist: An entity engaged to perform TAB Work.

1.3 Submittals

A. Certified TAB reports.

1.4 Quality Assurance

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 Examination

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine the approved submittals for HVAC systems and equipment.

C. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

D. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine test reports specified in individual system and equipment Sections.

G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine operating safety interlocks and controls on HVAC equipment.

I. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 Preparation

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 General Procedures For Testing And Balancing

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

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

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 General Procedures For Balancing Air Systems

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

C. Check airflow patterns from the outdoor-air louvers and dampers and exhaust-air dampers.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of air-handling-unit components.

J. Verify that air duct system is sealed as specified in Division 15 Section "Ductwork and Accessories."

3.5 Procedures For Constant-Volume Air Systems

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

B. Measure total airflow.

C. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

D. Measure fan static pressures as follows to determine actual static pressure:

1. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
2. Measure static pressure directly at the fan outlet or through the flexible connection.
3. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

E. Measure static pressure across each component that makes up an air-handling unit

1. Report the cleanliness status of filters and the time static pressures are measured.

F. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

G. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

H. Measure air outlets and inlets without making adjustments.

3.6 Tolerances

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.7 Final Report

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. Summary of contents including the following:
11. Indicated versus final performance.
12. Notable characteristics of systems.
13. Description of system operation sequence if it varies from the Contract Documents.
14. Nomenclature sheets for each item of equipment.
15. Data for terminal units, including manufacturer's name, type, size, and fittings.
16. Notes to explain why certain final data in the body of reports vary from indicated values.
17. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Fan drive settings including settings and percentage of maximum pitch diameter.
    d. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.8 Additional Tests

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.9 Final Inspection

A. Prior to final acceptance of the HVAC equipment and controls, a satisfactory start-up and functional testing shall be conducted by the contractor and witnessed by the HVAC engineer.

END OF SECTION