DIVISION 23: HEATING, VENTILATING, AND AIR CONDITIONING

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SECTION 23 0501

COMMON HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for HVAC systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Interface with Testing And Balancing Agency.
   4. Furnish and install sealants relating to installation of systems installed under this Division.
   5. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.
   6. Furnish and install sound, vibration, and seismic control elements.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.

C. Related Requirements:
   1. Section 03 3053: 'Miscellaneous Cast-In-Place Concrete' for exterior concrete pads and bases for mechanical equipment.
   2. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   3. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   4. Section 07 9213: 'Elastometric Joint Sealant' for quality of sealants used at building exterior.
   5. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustical sealants.
   6. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
   7. Section 26 2913: 'Enclosed Controllers' for magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
   8. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
   9. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.
   10. Sections Under 33 5000 Heading: Fuel Distribution Utilities.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
         2) Include name, address, and phone number of each supplier.
   2. Shop Drawings:
      a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
      b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
      c. Drawing of each temperature control panel identifying components in panels and their function.

d. Other shop drawings required by Division 23 trade Sections.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
(1) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
(2) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
(3) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
(4) Manual for Honeywell T7350 thermostat published by Honeywell.
c) Provide operating instructions to include:
(1) General description of each HVAC system.
(2) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
(3) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
b. Warranty Documentation:
1) Include copies of warranties required in individual Sections of Division 23.
c. Record Documentation:
1) Manufacturers documentation:
a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
3. Identification:
a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
1. Company:
a. Company specializing in performing work of this section.
1) Minimum five (5) years experience in HVAC installations.
2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
b. Upon request, submit documentation.
2. Installer:
a. Licensed for area of Project.
b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Accept valves on site in shipping containers with labeling in place.

B. Storage And Handling Requirements:
   1. In addition to requirements specified in Division 01:
      a. Stored material shall be readily accessible for inspection by Architect until installed.
      b. Store items subject to moisture damage, such as controls, in dry, heated spaces.
      c. Provide temporary protective coating on cast iron and steel valves.
      d. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   2. Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.

B. Special Warranty:
   1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
   2. If HVAC sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local HVAC sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
   1. Use domestic made pipe and pipe fittings on Project.
   2. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
   1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.

D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
   2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
   3. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   4. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.3 PREPARATION

A. Changes Due To Equipment Selection:
   1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
   2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
   3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
   4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

3.4 INSTALLATION

A. Interface With Other Work:
   1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
   2. Electrical: Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
   3. Testing And Balancing:
      a. Put HVAC systems into full operation and continue their operation during each working day of testing and balancing.
      b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for correct balance as recommended by Testing And Balancing Agency and at no additional cost to Owner.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
4. Determine exact route and location of each pipe and duct before fabrication.
   a. Right-Of-Way:
      1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
      2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
   b. Offsets, Transitions, and Changes in Direction:
      1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
      2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Piping:
1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
   a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
   b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
      1) Arrange so as to facilitate removal of tube bundles.
      2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
         a) Make connections of dissimilar metals with di-electric unions.
         b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
      3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
      4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
      5) Install piping to insure noiseless circulation.
      6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
   c. Do not install piping in shear walls.
2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
   b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
   c. Make changes in direction with proper fittings.
   d. Expansion of Thermoplastic Pipe:
      1) Provide for expansion in every 30 feet (9 meters) of straight run.
      2) Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.
3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
   a. Sleeves through floors shall extend 1/4 inch (6 mm) above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
   b. Sleeves through floors and foundation walls shall be watertight.

4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
   a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.

F. Sealants:
1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
2. Surface finishes shall exactly match existing finishes of same materials.

3.6 FIELD QUALITY CONTROL

A. Field Tests:
1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.7 SYSTEM START-UP

A. Off-Season Start-up:
1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
2. Notify Owner seven days minimum before scheduled start-up.
3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.

B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
2. Make adjustments to insure that:
   a. Equipment alignments and clearances are adjusted to allowable tolerances.
   b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.

c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
d. Miscellaneous alignings, tightenings, and adjustings are completed so systems are tight and free from leakage and equipment performs as intended.

3. Motors and accessories are completely operable.
4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
5. Adjust drives for proper alignment and tension.
6. Make certain filters in equipment for moving air are new and of specified type.
7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

3.8 CLEANING

A. Clean exposed piping, ductwork, and equipment.

B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.

C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

3.9 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of mechanical systems utilizing Operation And Maintenance Manual when so doing:
a. Minimum Instruction Periods:
1) HVAC: Eight (8) hours.
2) Temperature Control: Six (6) hours.
3) Refrigeration: Four (4) hours.
b. Conduct instruction periods after Substantial Completion inspection when systems are properly working and before final payment is made. None of these instructional periods shall overlap another.

3.10 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.

C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for HVAC systems.

B. Related Requirements:
   1. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   2. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

C. Products Installed But Not Furnished Under This Section:
   1. Stencils and band colors of gas piping used in HVAC equipment.

D. Related Requirements:
   1. Section 09 9124: 'Interior Painted Metal' for providing field painting of identification of piping used with HVAC equipment.
   2. Section 23 0553: 'Identification For HVAC Piping And Equipment' for HVAC piping and equipment identification signage requirements.
   3. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Section 09 9124 to coordinate with Section 23 0529 for location of identification of HVAC piping and equipment to be field painted and Section 23 0553 for painting requirements of HVAC piping and equipment.
   2. Section 23 0529 to coordinate with Section 23 0553 for stencil and band color locations and identification requirements of HVAC piping and equipment for field application.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Class Two Quality Standard Approved Manufacturers. See Section 01 6200:
      a. Anvil International, Portsmouth, NH www.anvilintl.com.
      b. Cooper B-Line, Highland, IL www.cooperbline.com.
      c. Erico International, Solon, OH www.erico.com.

d. Hilti Inc, Tulsa, OK www.hilti.com.
e. Minerallac, Hampshire, IL www.minerallac.com.
f. Thomas & Betts, Memphis, TN www.superstrut.com.
g. Unistrut, Wayne, MI www.unistrut.com.

B. Performance:
1. Design Criteria:
a. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size	Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller	10 mm	50 mm and smaller
1/2 inch	2-1/2 to 3-1/2 inches	13 mm	63 mm to 88 mm
5/8 inch	4 to 5 inches	16 mm	100 mm to 125 mm
3/4 inch	6 inches	19 mm	150 mm
7/8 inch	8 to 12 inches	22 mm	200 mm to 300 mm

b. Support rods for multiple pipes supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	50mm	63mm	75mm	100mm	125mm	150mm	200mm
2	10 mm	Two	0	0	0	0	0	0
2	13 mm	Three	Three	Two	0	0	0	0
2	16 mm	Six	Four	Three	Two	0	0	0
2	19 mm	Nine	Seven	Five	Three	Two	Two	0
2	22 mm	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi (69 Mpa).

C. Materials:
1. Hangers, Rods, Channels, Attachments, And Inserts:
a. Galvanized and UL approved for service intended.
b. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
c. Class Two Quality Standards:
1) Support insulated pipes with clevis hanger equal to Anvil Fig 260 or roller assembly equal to Anvil Fig 171 with an insulation protection shield equal to Anvil Fig 167. Gauge and length of shield shall be in accordance with Anvil design data.
2) Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to Anvil Fig 260. Support uninsulated copper pipe from hanger equal to Anvil Fig CT-65 copper plated hangers and otherwise fully suitable for use with copper tubing.
d. Riser Clamps For Vertical Piping:
1) Class Two Quality Standard: Anvil Figure 261.
2) Suitable for special nuts size 3/8 inch (9.5 mm) through 7/8 inch (22 mm) with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
3) Class Two Quality Standards:
a) Standard Inserts: Anvil Figure 282.
4) Class One Quality Standards:
a) Continuous Inserts: Unistrut P-3200 series.
b) Acceptable Manufacturers: Hilti, Thomas & Betts.
c) Equal as approved by Architect before installation. See Section 01 6200.
e. Furnace / Fan Coil Support Channel:
1) Class One Quality Standard: Unistrut P1000.
2) Acceptable Manufacturers: Hilti, Thomas & Betts.

3) Equal as approved by Architect before installation. See Section 01 6200.

f. Swivel Attachment:
1) Class One Quality Standard: Unistrut EM3127.
2) Acceptable Manufacturers: Hilti, Thomas & Betts.
3) Equal as approved by Architect before installation. See Section 01 6200.

EXECUTION

2.2 INSTALLATION

A. Piping:
1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
b. Supports For Horizontal Piping:
1) Support metal piping at 96 inches (2 400) mm on center maximum for pipe 1-1/4 inches (32 mm) or larger and 72 inches (1 800 mm) on center maximum for pipe 1-1/8 inch (28 mm) or less.
2) Support thermoplastic pipe at 48 inches (1 200 mm) on center maximum.
3) Provide support at each elbow. Install additional support as required.
c. Supports for Vertical Piping:
1) Place riser clamps at each floor or ceiling level.
2) Securely support clamps by structural members, which in turn are supported directly from building structure.
3) Provide clamps as necessary to brace pipe to wall.
d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
e. Expansion of Thermoplastic Pipe:
1) Provide for expansion in every 30 feet (9 meters) of straight run.
2) Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of and requirements for anchorage and seismic restraint systems and vibration isolation systems for HVAC piping and equipment.

B. Related Requirements:
   1. Section 03 3053: 'Miscellaneous Exterior Cast-In-Place Concrete'.
   2. Furnishing and installing of seismic restraint and vibration isolation systems is by installer of equipment requiring such systems. Manufacturers of equipment specified for seismic restraint shall provide product data needed for calculation of seismic restraint needs. This information shall include, but not be limited to, equipment dimensions, dimensioned anchor points, operating weight, and center of gravity dimension.

1.2 REFERENCES

A. Association Publications:
   1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
      a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
   2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
      a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
      b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:
   1. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:
   1. American National Standards Institute / Sheet Metal And Air Conditioning Contractors' National Association:
      a. ANSI/SMACNA 001-2008, 'Seismic Restraint Manual: Guidelines For Mechanical Systems' (3rd Edition).
   2. American Society of Civil Engineers / Structural Engineering Institute:
      a. ASCE/SEI 7-10, 'Minimum Design Loads for Buildings and Other Structures'.
         1) Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
   3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. 2011 ASHRAE Handbook - HVAC Applications.
         1) Chapter 48, 'Noise and Vibration Control'.
         2) Chapter 55, 'Seismic- and Wind-Resistant Design'.
   4. ASTM International:
      a. ASTM A615/A615M-12, 'Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Restraint system and anchorage method to be used for each piece of equipment.
      b. Seismic restraints and calculations for all flexible mounted equipment.
      c. Vibration isolators and flexible couplings.
      d. Clearly outlined procedures for installing and adjusting isolators, seismic bracing anchors, and snubbers.
   2. Shop Drawings:
      a. Show size, hanger length, and location of seismic restraints for piping and ductwork.
      b. Show details for each isolator and seismic brace with snubbers proposed for specified equipment.
      c. Show details for proposed structural steel frames and rails and for anchors to be used in conjunction with isolation of equipment.
      d. Show locations of piping and ductwork restraints on installation and fabrication floor plans (not bid set of documents of floor plans), noting size and type of restraint to be used.
      e. Show details of supports, hangers, anchorage, and bracing for isolated equipment as designed or proposed by professional engineer employed by Restraint Manufacturer and qualified with seismic experience in bracing for mechanical equipment. Shop drawings submitted for seismic bracing and anchors shall bear engineer's signed professional seal.
      f. Include anchor bolt calculations, signed and stamped by registered engineer, showing adequacy of bolt sizing and type.
         1) Calculations shall include anchor embedment, minimum edge distance and minimum center distance.
         2) Design lateral forces shall be distributed in proportion to mass distribution of equipment.
         3) Furnish calculations for anchors on restraint devices, cable, isolators, and on rigidly mounted equipment.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. System design and installation shall meet seismic requirements as defined in ASCE/SEI 7-10, 'Minimum Design Loads for Buildings and Other Structures' and applicable state and local codes in accordance with minimum restraint capability of 1.0 g.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Type One Acceptable Manufacturers:
      a. Amber / Booth Company, Houston, TX www.amberbooth.com.
      b. Mason Industries Inc, Hauppauge, NY www.mason-ind.com.
      c. Vibration Mountings and Control Inc, Bloomington, NJ (201) 838-1780.
      d. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
   1. Design Criteria:
      a. Isolation And Seismic Equipment:
         1) Piping: Restrain piping in accordance with ANSI/SMACNA 001 Seismic Restraint Manual, Chapter 4, Figures 4.11 to 4.19.
         2) Equipment with Fixed Anchor or Support:
            a) Restraint designed according to ASCE/SEI 7-10, Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
            b) Horizontal force factor for elements of structures:

(1) In addition, vertical force restraint requirement shall be computed at 1/2 value of horizontal forces.
(2) Restrain equipment not anchored directly to floors by cable system designed and furnished by Restraint Manufacturer.

3) Ductwork: Restrain ductwork in accordance with ANSI/SMACNA 001 Seismic Restraint Manual, Chapter 4, Figures 4.2 to 4.10 as appropriate.

b. Vibration Isolation Requirements:
1) Isolate equipment from structure by means of resilient vibration and noise isolators.
2) Unless otherwise noted, isolate HVAC equipment one horsepower and over from structure by means of resilient vibration and noise isolators in accordance with ASHRAE 'Handbook - HVAC Applications', Chapter 48, Table 1, 'Design Guidelines for HVAC-Related Background Sound in Rooms'.
3) Design and install isolation equipment, hangers, connections, and other isolating devices to prevent transmission of vibration to structure from equipment and associated piping and ductwork.
4) For floor-mounted equipment, use recommendations with ASHRAE 'Handbook - HVAC Applications', Chapter 48, Table 1, 'Design Guidelines for HVAC-Related Background Sound in Rooms'.
5) For roofs and floors constructed with open web joints, thin long span slabs, wooden construction and unusual light weight construction, evaluate equipment weighing more than 300 pounds to determine additional deflection of structure caused by equipment weight. Isolator deflection shall be 15 times additional deflection or deflection shown in ASHRAE 'Handbook - HVAC Applications', Chapter 48, Table 1, 'Design Guidelines for HVAC-Related Background Sound in Rooms', whichever is greater.
6) Under-Equipment Spring Isolators:
a) Equal to Mason SSLFH earthquake motion restrained spring mounts with freestanding stable steel springs, leveling bolts, corrosion resistant finish, motion limiting design, uplift restraining bolts, and 1/4 inch (6 mm) ribbed neoprene noise stop pad.
b) Isolators shall accept force in any direction up to 1.0 g without failure, and shall limit movement to 3/4 inch (19 mm) in any direction.
c) Springs shall have 50 percent overload capacity.
d) Size as required to achieve specified static deflection.
e) Outer diameter of spring proper shall not be less than 0.8 of spring height when in loaded position.
7) Overhead Support Spring And Rubber Hangers:
a) Combination spring and neoprene hangers.
b) Hanger bracket shall have 500 percent overload capability and shall allow up to 15 degree hanger rod misalignment without short-circuiting.
c) Springs shall have 50 percent overload capacity.
d) Provide seismic bracing as required.
8) Isolate piping and ductwork in mechanical equipment room and piping and ductwork three supports away or 50 feet (15 meters) from other mechanical equipment, whichever is greater, from structure by means of vibration and noise isolators.
a) Isolate suspended piping with combination spring and fiberglass hangers in supporting rods.
b) Support floor-mounted piping directly on spring mounts.
9) Isolate vertical pipe risers from structure using vibration and noise isolating expansion hangers having minimum rated deflection of four times anticipated pipe movement. Enclose in housing for fail-safe equipment.
10) Incorporate flexible connectors in piping adjacent to reciprocating equipment.
11) Incorporate flexible connections in ductwork adjacent to air-moving units.
12) Elastomeric Isolator: Neoprene or high quality synthetic rubber with anti-ozone and anti-oxidant additives.
13) Nuts, Bolts, And Washers: Electroplated zinc.
14) Isolators Exposed To Weather: Cadmium plated and neoprene coated springs.

c. Seismic Requirements:
1) Mechanical equipment, piping, and ductwork shall be braced, snubbed, or supported to withstand seismic disturbances and remain operational.
2) Seismic restraint equipment and resilient isolation devices shall be designed and furnished by single Manufacturer:

C. Finishes:
   1. Clean and paint steel components. Thoroughly clean structural steel bases of welding slag and prime with zinc-chromate or metal etching primer. Etch and paint hot dipped galvanized steel components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Isolation Equipment:
   1. Mount vibration isolated equipment on rigid steel frames or concrete bases unless Equipment Manufacturer certifies direct attachment capability.
   2. Install snubbers with factory set clearances.
   3. Piping:
      a. Protect isolated and non-isolated piping 2-1/2 inches (64 mm) inside diameter and larger in all planes by restraints to accommodate thermal movement as well as restrain seismic motions.
      b. Locations shall be as scheduled and include, but not be limited to:
         1) At drops to equipment and at flexible connections.
         2) At 45 degree or greater changes in direction of pipe.
         3) At horizontal runs of pipe 30 feet (9.15 m) maximum on center spacing.
         4) Gas piping shall have additional restraints as scheduled.
   4. Ductwork:
      a. Protect isolated and non-isolated rectangular ductwork 4 feet square (0.372 sq m) in cross-sectional area and larger in all planes by restraints to accommodate thermal movement as well as restrain seismic motion.
      b. Locations shall be determined by Seismic Restraint Manufacturer and include, but not be limited to:
         1) Horizontal runs of ductwork 30 feet (9.15 m) maximum on center spacing.
         2) 45 degree or greater changes in direction of ductwork.
         3) Each end of duct runs and drops of equipment.
         4) Each flexible connection.

B. Vibration Isolation: Install piping and ductwork to prevent transmission of noise and vibration into structure.

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But not Installed Under This Section:
   1. Identification of HVAC piping and equipment as described in Contract Documents including:
      a. Paint identification for gas piping used in HVAC equipment.
      b. Stencils and band colors for gas piping used in HVAC equipment.

B. Related Requirements:
   1. Section 09 9124: 'Interior Painted Metal' for providing field painting of identification of piping used with HVAC equipment.
   2. Section 22 0529: 'Hangers And Supports For Plumbing' for field installation of pipe stencils and band colors for identification for piping used with HVAC equipment.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Description:
   1. Abbreviations for Pipe Stencils and Equipment Identification and Band Colors for Pipe Identification:
      a. Apply stenciled symbols and continuous painting as follows:

Pipe Type	Pipe Color	Symbol
Gas	Yellow	Gas

B. Materials:
   1. Category Four Approved Products and Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Description:
      a. Ferrous Metal:
         1) New Surfaces: Use MPI(a) INT 5.1B Waterborne Light Industrial Finish system.
         2) Previously Finished Surfaces: Use MPI(r) RIN 5.1B Waterborne Light Industrial Finish system.
   3. Performance Requirements:
      a. New Surfaces: MPI Premium Grade finish requirements.
      b. Deteriorated Existing Surfaces: MPI Premium Grade finish requirements.
      c. Sound Existing Surfaces: MPI Custom Grade finish requirements.
      d. Maintain specified colors, shades, and contrasts.
   4. Paint (one coat):
      a. Primer:
         1) Ferrous Metal:
            a) MPI 107, 'Primer, Rust-Inhibitive, Water Based'.
               (1) Color: white.
      b. Finish Coat (two coats):
         1) Ferrous Metal:
            a) MPI 153, 'Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss Level 5)'.
   5. Labels:

a. Equipment Identification:
   1) Black formica, with white reveal when engraved.
   2) Lettering to be 3/16 inch (5 mm) high minimum.

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
      a. Thermostats and control panels in mechanical spaces (attach label to wall directly above or below thermostats).
      b. Furnaces.
      c. Condensing units.
      d. Accessible exhaust fans.
   2. Engrave following data from Equipment Schedules on Drawings onto labels:
      a. Equipment mark.
      b. Area served.
      c. Thermostat zone number, when different from equipment mark.
      d. Panel and breaker from which unit is powered.

B. Painting:
   1. New Surfaces:
      a. Remove rust spots by sanding and immediately spot prime. If all traces of rust cannot be removed, apply rust blocker recommended by Paint Manufacturer before applying full primer coat.
   2. Leave equipment in like-new appearance.
   3. Only painted legends, directional arrows, and color bands are acceptable.
   4. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
      a. Adjacent to each item of equipment.
      b. At point of entry and exit where piping goes through wall.
      c. On each riser and junction.
      d. Every 25 feet (7.620 m) on long continuous lines.
      e. Stenciled symbols shall be one inch (25 mm) high and black.

END OF SECTION

SECTION 23 0713

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install thermal wrap duct insulation as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3114: 'Low-Pressure Metal Ducts'.
   2. Section 23 3300: 'Acoustic Duct Accessories' for duct liner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Certainteed St Gobain, Valley Forge, PA www.certainteed.com.
   2. Johns-Manville, Denver, CO www.jm.com.
   3. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com or Toronto, ON (416) 593-4322.
   4. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
   5. Owens-Corning, Toledo, OH or Owens-Corning Canada Inc, Willowdale, ON www.owenscorning.com.

2.2 MATERIALS

A. Thermal Wrap Duct Insulation:
   1. 1-1/2 inch (38 mm) or 3 inch (76 mm) thick fiberglass with factory-laminated, reinforced aluminum foil scrim kraft facing and density of 0.75 lb / per cu ft (12 kg / per cu m).
   2. Thermal Conductivity: 0.27 BTU in/HR SF deg F at 75 deg F (24 deg C) maximum.
   3. Type One Acceptable Products:
      a. Type 75 standard duct insulation by Certainteed St Gobain.
      b. Microlite FSK by Johns-Manville.
      c. Duct Wrap FSK by Knauf Fiber Glass.
      d. Alley Wrap FSK by Manson Insulation Inc.
      e. FRK by Owens-Corning.
      f. Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Thermal Wrap Duct Insulation:
   1. Install insulation as follows:
      a. Within Building Insulation Envelope:
         1) 1-1/2 inches (38 mm) thick on rectangular outside air ducts and combustion air ducts.
         2) 1-1/2 inches (38 mm) thick on all round ducts.
      b. Outside Building Insulation Envelope:

1) 3 inch (76 mm) thick on round supply and return air ducts.
2) 1-1/2 inch (38 mm) thick on rectangular, acoustically lined, supply and return air ducts.

2. Wrap insulation tightly on ductwork with circumferential joints butted and longitudinal joints overlapped minimum 2 inches (50 mm).
   a. Do not compress insulation except in areas of structural interference. Minimum thickness at corners shall be one inch (25 mm) thick.
   b. Remove insulation from lap before stapling.
   c. Staple seams at approximately 16 inches (400 mm) on center with outward clenching staples.
   d. Seal seams with foil vapor barrier tape or vapor barrier mastic. Seal penetrations of facing to provide vapor tight system.

B. Insulate outside of ceiling diffusers, diffuser drops, and duct silencers same as ductwork.

END OF SECTION

SECTION 23 0719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'General HVAC Requirements'.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Keep materials and work dry and free from damage.
   2. Replace wet or damaged materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armacell, Mebane, NC www.armaflex.com.
      b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
      c. Foster Products Corp, Oakdale, MN www.fosterproducts.com.
      d. Johns-Manville, Denver, CO www.jm.com.
      e. Knauf, Shelbyville, IN www.knauffiberglass.com.
      f. Manson, Brossard, BC, Canada www.isolationmanson.com.
      g. Nitron Industries, Thousand Oaks, CA www.nitronindustries.com.
      h. Owens-Corning, Toledo, OH www.owenscorning.com or Owens-Corning Canada Inc, Willowdale, ON (416) 733-1600.
      i. Ramco, Lawrenceville, NJ www.ramco.com.
      j. Nomac, Zebulon, NC www.nomaco.com.
      k. Speedline Corp, Solon, OH www.speedlinepvc.com.

B. Materials:
   1. Refrigeration Piping System:
      a. Thickness:

Pipe Size, Outside Diameter	Insulation Thickness
One inch and smaller	1/2 Inch
1-1/8 to 2 inch	3/4 Inch

1) One inch sheet for fittings as recommended by Manufacturer.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
   a) AP Armaflex 25/50 by Armacell.
   b) Nitrolite by Nitron Industries. White only for exterior.
   c) Nomaco K-Flex.

b. Joint Sealer:
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Armacell 520 by Armacell.
      b) Namaco K-Flex R-373.
c. Insulation Tape:
   1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) Armaflex AP Insul Tape by Armacell.
      b) FT182 Tape by Nitron Industries.
      c) Elastomeric Foamtape by Nomac K-Flex.
d. Exterior Finish:
   1) For application to non-white, exterior insulation.
   2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) WB Armaflex Finish by Armacell.
      b) R-374 Protective Coating by Nomaco K-Flex.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before application of insulating materials, brush clean surfaces to be insulated and make free from rust, scale, grease, dirt, moisture, and any other deleterious materials.

B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the work.

3.2 INSTALLATION

A. Refrigeration System Piping System:
   1. General:
      a. Install insulation in snug contact with pipe.
         1) Insulate flexible pipe connectors.
         2) Insulate thermal expansion valves with insulating tape.
         3) Insulate fittings with sheet insulation and as recommended by Manufacturer.
      b. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
      c. Do not install insulation on lines through clamp assembly of pipe support. Butt insulation up against sides of clamp assembly.
      d. Stagger joints on layered insulation. Seal joints in insulation.
      e. Install insulation exposed outside building so 'slit' joint seams are placed on bottom of pipe.
      f. Paint exterior exposed, non-white insulation with two coats of specified exterior finish.
   2. System Requirements:
      a. Condensing Units: Install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve.
      b. Split System Heat Pump Units: Install insulation on above ground refrigerant liquid and suction piping and fittings.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Method of installing insulation shall be subject to approval of Architect. Sloppy or unworkmanlike installations are not acceptable.

3.4 CLEANING

A. Leave premises thoroughly clean and free from insulating debris.

3.5 PROTECTION

A. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

END OF SECTION

SECTION 23 0933

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install automatic temperature control system as described in Contract Documents.
   2. Furnish and install conductors and make connections to control devices, motors, and associated equipment.
   3. Assist in air test and balance procedure.

B. Related Requirements:
   1. Section 01 4546: Duct testing, adjusting, and balancing of ductwork.
   2. Section 23 0501: Common HVAC Requirements.
   3. Section 23 3300: Furnishing and installing of temperature control dampers.
   4. Division 26:
      a. Furnishing and installing of raceway, conduit, and junction boxes, including pull wires, for temperature control system except as noted above.
      b. Power wiring to magnetic starters, disconnect switches, and motors.
      c. Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Installer to provide product literature or cut sheets for all products specified in Project.
      b. Installer to provide questions of control equipment locations to Mechanical Engineer prior to installation.

B. Informational Submittals:
   1. Certificates:
      a. Installer must provide ‘Certificate of Sponsorship’ signed from Approved Distributor with bid confirming Installer sponsorship.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Leave with O&M Manual specified in Section 23 0501.
      b. Record Documentation:
         1) Installer's 'Certificate of Sponsorship'.

1.3 QUALITY ASSURANCE

A. Qualifications: Requirements of Section 01 4301 applies, but is not limited to the following:
   1. Installer:
      a. Before bidding, obtain sponsorship from a local, Approved Distributor specified under PART 2 PRODUCTS of this specification. Initial requirements for sponsorship are:
         1) Receive product training from Approved Distributor.
         2) Exhibit RedLINK/Commercial system skills to sponsoring Approved Distributor.
         3) Installer to provide Distributor sponsorship by submitting ‘Certificate of Sponsorship’ as Informational Submittal with bid. Certificate available as Attachment in this Specification.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Manufacturer Contact List:
a. Air Products & Controls Ltd, Pontiac, MI www.ap-c.com.
b. Fire-Lite Alarms, Northford, CT www.firelite.com.
c. Honeywell Inc, Minneapolis, MN www.honeywell.com.
1) Primary Contact: Chris Brinkerhoff, (801) 550-3344, chris.brinkerhoff@honeywell.com.
d. ICCA Firex, Carol Stream, IL www.icca.invensys.com.
e. Insul_Guard, Salt Lake City, UT:
1) Primary Contact: Dan Craner, (801) 518-3733, insul_guard@comcast.net.
f. System Sensor, St Charles, IL www.systemsensor.com.
g. Zimmerman Technologies, Renton, WA:
1) Primary Contact: Tracy Zimmerman, (425) 255-1906, zimmtech@yahoo.com.

B. Distributors: Obtain RedLINK devices, RP panels, thermostats, and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301:
1. Idaho:
a. Control Equipment Co: (800) 452-1457 rhowe@controlequiputah.com Ray Howe.
b. Control Solutions & Design: (208) 375-4422 pdl@csdidaho.com Paul Lachowsky.
c. Relevant Solutions LLC: (801) 214-3313 Kathy.Wright@relevantsolutions.com Kathy Wright.
d. RSD Total Control: (720) 648-2597 mjohnson@rsdtc.com Mark Johnson.
2. Utah:
a. Control Equipment Co: (800) 452-1457 rhowe@controlequiputah.com Ray Howe.
b. Relevant Solutions LLC: (801) 214-3313 Kathy.Wright@relevantsolutions.com Kathy Wright.
c. RSD Total Control: (720) 648-2597 mjohnson@rsdtc.com Mark Johnson.

C. Performance:
1. Design Criteria:
a. Honeywell Prestige IAQ thermostat system with RedLINK Internet Gateway(s):
1) General Requirements:
a) Controls multistage equipment, dehumidification and ventilation with 2 wire connection to thermostat location into occupied space.
b) Adjust backlight preference to darken screen after 45 seconds of setting adjustments.
c) Programmable from keypad or USB Port memory stick.
d) Prestige thermostat design utilizes wireless communicating thermostats with EIM located near furnace, with electronic thermostat located in building space.
e) Thermostat system shall control outdoor ventilation air based upon TOD schedule for electric / electronic actuation of dampers.
f) CO2 sensors will open dampers only when CO2 exceeds 1200 ppm for energy savings.
g) RedLINK wireless network enables devices access via internet browser/ Apps via RIG module(s).
h) Wireless room sensors (temperature and humidity) & Outdoor Air sensor can be added as specified.
2) System Requirements:
a) Up to 4 Heat/2 Cool Heat Pumps; Up to 3 Heat/2 Cool Conventional Systems.
b) Used with Honeywell RedLINK enabled thermostats and accessories.
c) Tri-Lingual Display (Selectable for English, Spanish, or French).
d) 18 to 30 Vac.
e) 50 Hz; 60 Hz.
f) System Position to include Auto changeover for Heat-Cool.
g) 7-Day Programming.
h) 365-Day Event Scheduling.
i) Display Security Lockout options.
j) Minimum/ Maximum Temperature Range Stops.
k) 1,2,3,4 hour over-ride option.

l) Remote Access via internet, free Apple App, free Droid App.
m) Dehumidification setting range 40 to 80% RH.
n) Return Air and Discharge Air Sensors calculate Delta T for equipment diagnostics.

D. Components:
1. Thermostats And Sensors:
a. Thermostat and Sensor Kit:
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) Part Number Honeywell YTHX9421R5085WW consisting of following:
(1) Communicating Thermostat THX9421R5021WW.
(2) Discharge Air / Return Air Sensors: Honeywell C7735A1000, 10k ohms.
(3) Equipment Interface Module (EIM) THM5421R1021.
b) Wall Cover Plate: Honeywell THP2400A1027W.
b. Outdoor Air Sensor: Honeywell C7089R1013.
c. Remote Room Temperature/ Humidity Sensor:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Honeywell C7189R1004, plain face, wireless temperature/humidity.
b) Honeywell REM5000R1001, Portable Comfort Control.
d. Internet Gateway Module(s): One (1) module per four (4) thermostats.
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) Honeywell THM6000R1002, RIG Redlink Internet Gateway module.
2. Control for Electric Wall Heater:
a. Wireless Electric Heater Control:
1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
a) Part Number Honeywell YTL9160AR1000 consisting of following:
(1) Wireless RedLINK thermostat TL9160AR1002.
(2) Equipment Interface Module & Antenna TLM1110R1000.
3. Sealant Compound:
a. Description:
1) Non hardening waterproof, vapor proof, self-adhesive for hot or cold application for sealing conduit openings against drafts, dust moisture and noise.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) Duct Seal Compound No. DS-130 by Gardner Bender, Menomonee Falls , WI. www.gardnerbender.com.
2) Thumb-Tite Sealing Compound No. 4216-92 by Nu-Calgon, St. Louis, MO www.nucalgon.com.
4. Guard For Cultural Center Sensors:
a. Match color of sensor.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) MSI-244 thermostat guard with integral wood base by Zimmerman Technologies.
2) WMG 1 thermostat guard by Insul_Guard.
5. Duct Smoke Detectors:
a. Duct mounted smoke detector in systems with airflow greater than 2000 CFM.
b. Intelligent low flow photoelectric duct smoke detector with flash scan.
c. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) System Sensor Model D4120.
6. Transformer:
a. 120 **/** 24 V, 50VA Honeywell AT150F.
b. 120 **/** 24 V, 75VA Honeywell AT175F.
7. Damper Actuators:
a. Electric type equipped for Class I wiring.
b. Shall not consume power during UNOCCUPIED cycle or use chemicals or expandable media.
c. Have built in spring return.
d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) Honeywell MS8105A1030/U.
2) Honeywell MS8105A1130 w/ End switch.
8. Conductors:
a. Color-coded and No. 16 and No. 12 AWG Type TWN, TFN, or THHN, stranded.
b. Thermostat Cable: 12, 8, or 4 conductor, 18AWG solid copper wire, insulated with high-density polyethylene. Conductors parallel enclosed in brown PVC jacket (22 AWG cable not allowed).

c. Communicating Cable:
1) Class Two Quality Standard. See Section 01 6200:
a) CAT 4, 22 gauge (0.025 in) (0.645 mm), twisted pair, non-plenum and non-shielded cable.

9. Local Relay (RP) Panels For Chapel And Cultural Center Systems:
a. 16-ga (1.59 mm) screw cover, painted sheet metal. Box with cover and knockouts, pre-wired terminal strips, relay, and transformer.
b. Provide Labels with Distributor contact information on each panel.
c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Standard: LDS Model RP-6.

10. CO_2 Return Air Sensor:
a. Duct mount with display.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) Honeywell: C7232B1006.

11. Combination Equipment Interface Module and Thermal Overload Switch Panel:
a. CEO panel must be provided by approved panel builder. See Section 01 6200 for definitions of Categories:
1) CEO panel wireless thermostat must be programmed by panel builder prior to installation.
2) Thermostat programming parameters:
a) Format: ºC ºF.
b) Hour: 12 hour format.
c) Setpoint: 41 degree.
d) Minimum temperature setpoint: 41 degree, default.
e) Maximum temperature setpoint: 50 degree.
f) Anti-Freeze: On.
g) Lock: All.
h) Recovery: Off.
i) Schedule: Off.
3) Wireless thermostat shall be mounted close to fire riser piping.
4) Connect to RedLINK RIG as required.

E. Operation Sequences:
1. Programmable thermostat shall control unoccupied and occupied status of fan system based on adjustable seven day program and remote room sensor **/** push button. Fan shall run continuously in occupied mode and cycle in unoccupied mode.
2. Adjustable heating and cooling set points shall control space temperature by activating either heating or cooling equipment. Programmable thermostat provides automatic change over between heating and cooling.
3. Remote room sensor provides optional override of thermostat program by allowing three hour timed override of thermostat program at any time by pushing ON / OFF button on remote room sensor cover. This shall activate thermostat to occupied mode and system shall control to occupied set point.
4. Minimum outside air damper, spring return type, shall open in occupied mode and remain closed in unoccupied mode in zones using outside air.
5. Two Sensor Averaging, Stake and Bishop zones:
a. Sensors shall control zone HVAC equipment by averaging temperature in spaces containing sensors.
b. Prestige thermostat can typically be located in unlocked common space such as hallway. When applied in such fashion, thermostat shall read temperature(s) from wireless remote sensor(s) and is used for temperature override functions only.
c. Prestige thermostat can be installed in High Council room with Portable Comfort Control (handheld) or wireless temperature sensor to be located in Stake Presidents (if included) / Bishops office(s.
6. Three Sensor Averaging:
a. Sensors shall control zone HVAC equipment by averaging temperature in spaces containing sensors.
7. On zones including Energy Recovery Ventilator (ERV), ERV shall activate in Occupied Mode and remain inactive in Unoccupied Mode:
a. Zones with ERV's and CO_2 sensors will remain inactive during Occupied Mode until CO_2 actives as outlined below.

8. Systems Using CO_2 sensor to Control Outside Air Damper Operation:
   a. Minimum outside air damper, spring reurn type, shall open in occupied mode only when CO_2 sensor setpoint of 1200 ppm is reached. Damper shall close if CO_2 level drops below 1100 ppm.
   b. Damper shall remain closed in un-occupied mode.

PART 3 - EXECUTION

PART 4 - INSTALLERS

A. Acceptable Installers. See Section 01 4301:
   1. Approved HVAC Sub-Contractors shall be pre-approved and included in Construction Documents by Addendum.

4.2 INSTALLATION

A. Interface With Other Work:
   1. Calibrate room thermostats as required during air test and balance. Insulate sensor J-box with fiberglass insulation; expandable/ foam insulation is NOT acceptable.
   2. Instruct air test and balance personnel in proper use and setting of control system components.
   3. Install low voltage electrical wiring in accordance with Division 26 of these Specifications.

B. Communication RIG Module:
   1. RIG and all RedLINK wireless modules need to be installed at least 24 inches (610 mm) from any other RedLINK device.
      a. If RIG fails to communicate with other RedLINK devices, relocate RIG where signal can be received.

C. Control for Electric Wall Heater.
   1. Install according to local code the electric heater EIM into electric heater unit.
   2. Install antenna outside metal heater panel and visible to the view.
   3. Install wireless thermostat in room controlled by heater.
   4. Commission thermostat to be seen by RIG gateway and webpage.

D. Safety Controls:
   1. Interlock main return air duct smoke detectors to keep heating, cooling, and system fan from operating when detector is energized. Interlock smoke detector for combination fire / smoke dampers so fire / smoke damper closes on detection of smoke.
   2. Interlock gas valves with cooling compressors and supply air fan.
   3. Gas valves shall obtain their electrical control power from same circuit as supply fan motor.
   4. Check high limit thermostats furnished with heating equipment for correct operation. Gas valves shall close when duct temperature exceeds high limit setting. Perform this work immediately after wiring burner controls.
   5. Wire bonnet thermostatic switches to dissipate all heat in combustion chambers.
   6. Fresh air dampers shall close on fan shut-down, power failure, open fan motor disconnect switch, and when thermostat is in UNOCCUPIED mode.
   7. Gas burner safety controls furnished with furnace units shall be incorporated in control circuits for all modes of operation.
   8. Control twinned furnace systems, where two furnaces serve common supply and return plenums, as one unit with twinning kit. Motors shall start and stop together and gas valves operate together.

E. Mount damper actuators and actuator linkages external of airflow. Make certain dampers operate freely without binding or with actuator housing moving.

F. Paste copy of record control wiring diagram on back of relay panel door cover for each multiple furnace system.

4.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Calibrate, adjust, and set controls for proper operation, operate systems, and be prepared to prove operation of any part of control system. This work is to be completed before pre-substantial completion inspection.
   2. Test each individual heating, cooling, and damper control for proper operation using control system.

4.4 SYSTEM STARTUP

A. For systems with Prestige Thermostat.
   1. Contractor is responsible for a fully functioning control system accessible via internet web browser. Contractor is responsible to coordinate Network start up with assistance from local IT technician. Local IT technician shall provide available ports on network switch for RIG devices.
   2. Contractor is responsible configuring all thermostats with proper zone names, zone scheduling, proper Church conference / holiday scheduling, all to be coordinated with local FM manager. Set proper clock setting including day/month/year.
   3. Set Heating / Cooling to proper stages
   4. Set heat cycle rates to 9 cph and cooling to 4 cph.
   5. Set Aux relay to “Time of Day”.
   6. Set System switch operation to “Automatic” changeover.
   7. Set fan switch operation to “ON”.
   8. Set minimum UnOcc start time for all days. No days shall be scheduled Unconfigured.
   9. Set occupied start times to match meeting start times; provided by local FM manager.
   10. Place all zone over-ride durations to one (1) hour except for Bishop and Stake area which shall be set to two (2) hours.
   11. Set Occupied default heating setpoints to 70 degrees, cooling setpoints to 74 degrees.
   12. Set UnOccupied default heating setpoint to 60 degrees, cooling setpoints to 90 degrees.
   13. Set each zone to applicable Holiday scheduling for General & Stake Conferences.

4.5 ADJUSTING

A. Prestige thermostat configuration settings; the following are configuration guidelines for consistent installations:
   1. 1000 English/French/Spanish (depending upon region).
   2. 1010 Commercial.
   3. 1030 Zone Name (display on Home Screen).
   4. 1040 Programmable.
   5. 2000 Conventional / Heat Pump (match equipment).
   6. 2010 Standard / High Efficiency (match equipment).
   7. 2070 Heating / Cooling Stages (match equipment).
   8. 2220 A- L/A Terminal Setup (Time of Day).
   9. 3000 Changeover (Automatic) Deadband (3 degrees).
   10. 3010 Advanced Option +PID Settings – Change cooling settings to 4 cph and heating to 6 (mild climates and 9 cph (cold climates).
   11. 3240 Minimum Compressor Off Time (3 minutes).
   12. 4000 Number of Schedules periods (4 Periods Per Day).
   13. 4010 Pre-Occupancy Purge Duration (off).
   14. 4020 Type of Override (Standard).
   15. 4030 Override Duration (1hr for classrooms, 2 hours for Stake and Bishops zones).
   16. 4050 Heat Recovery (default setting).
   17. 4060 Heat Recovery (default setting).
   18. 4070 Cooling Recovery (default setting).
   19. 4080 Cooling Recovery (default setting).
   20. 4100 Temperature Range Stops (Minimum Cooling setpoint 69 degrees, Maximum Heating Setpoint 73 degrees F.
   21. 5000 Return Air (check) Discharge Air (Check).

22. 5070 Return Air Sensor (EIM – S2).
23. 5080 (10K).
24. 5090 Discharge Air Sensor (EIM – S1).
25. 5100 (10K).
26. 5110 A-Coil Low Temperature Cutoff (35 degrees).
27. 7000 – 8700 (default).
    Section 9000- 9210 for dehumidification application.
28. 10000 Ventilation Type (None / damper end-switch will control ERV).
29. 10170 – 12000 (Default).
30. 13000 Heat Delta T Diagnostics (On).
31. 13010 Cooling Delta T Diagnostics (On).
32. 13015 Set Advanced Delta T Diagnostics Options (No).
33. 14000 – 15020 (default) Contractor is NOT to install business card.
34. SYSTEM SWITCH Setting (Make sure system is set for Automatic).
35. MENU/ PREFERENCES/ DISPLAY OPTIONS/ BACKLIGHT (set to 0 Dim).
36. MENU/ Holiday-Event Scheduler / Custom Events/ Create new event.
    a. Mountain Time Zone:
        1) First Sunday in April: Occupy all zones for all day / every year.
        2) First Sunday in April: UnOccupy all zones for all day / every year.
        3) First Sunday in October: Occupy all zones for all day / every year.
        4) First Sunday in October: UnOccupy all zones for all day / every year.

B. Wireless thermostat for electric wall heater configuration:
    1. Temperature: (ºC / ºF).
    2. Minimum setpoint: (7ºC / 45ºF).
    3. Maximum setpoint: (21ºC / 70ºF).
    4. Anti-freeze: (On)
    5. Keypad Lock: (All)
    6. Zone name (54*): * from TCC manually change from “Utility Room” to “Fire-riser room”.
    7. Adaptive Intelligent Recovery: (Off).
    8. Programmable mode: (On)
    9. Set time, date and weekly schedule.
    10. Set temperature to maintain 45ºF / 7ºC.
    11. Lock out thermostat.

4.6 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
    1. Include as part of training required in Section 23 0501, following training:
        a. Training shall be by personnel of installing company and utilize operator’s manuals and as-built documentation.
        b. Provide training in (2) two sessions including Mytotalconnectcomfort sight & smart Apps for up to four (4) hours total.
            1) First session will occur between system completion and Substantial Completion.
            2) Second session will occur within forty five (45) days of Substantial Completion when agreed upon by Owner.
        c. Training shall include sequence of operation review, selection of displays, modification of schedules and setpoints, troubleshooting of sensors, etc, as follows:
            1) Control System Overview:
                a) Show access to system through both individual thermostats and Internet browser via mytotalconnectcomfort and how network works. Scheduling building at minimum for Stake and General Conference, special events.
            2) Thermostat Programming from Keypad and USB memory stick: Instructions on developing setpoints and schedules and adjusting local zone temperatures.
            3) Thermostat Operation:
                a) Identify and explain security settings and screen lockouts.
            4) Web Internet training with local Facilities Manager during two (2) sessions.

a) Review all features accessible from the ‘Settings’ tab including Alarm points, user access, scheduling and humidity setpoints (where applied).

END OF SECTION

ATTACHMENTS

CERTIFICATE OF SPONSORSHIP
Electric and Electronic Control System for HVAC Installer

PROJECT INFORMATION (To be filled out by Installer - available from project specification):

Project Name: _____

Project Number: _____

Project Address: _____

INSTALLER INFORMATION (To be filled out by Installer):

Installer Name: _____

Installer Firm: _____

Installer Address: _____

I acknowledge and confirm the above listed Installer has received training and exhibit RedLINK/Commercial System skills and is qualified to install the automation control system as specified for Project identified above. Our company will stand behind the Installer meeting the legal specified performance requirements.

Sponsoring Approved Honeywell Distributor Name: _____

Signature: _____ Printed Signature: _____

Date: _____

SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for work of this Section.
   2. Furnish and install gas piping and fittings within building and from building to meter including connection to meter as described in Contract Documents.

B. Related Requirements:
   1. Sections Under 09 9000 Heading: Painting of exterior piping.
   2. Section 23 0501: 'Common HVAC Requirements'.
   3. Section 31 2316: 'Excavation' for procedure and quality of excavation.
   4. Section 31 2323: 'Fill" for procedure and quality of backfill and compaction.
   5. Section 33 5100: 'Natural-Gas Distribution' for gas line from meter to main.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A53/A53M-12, ‘Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless’.
      b. ASTM A234/A234M-11a, ‘Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service’.
      c. ASTM D2513-12ae1, ‘Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings’.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Welders:
      a. Welders shall be certified and bear evidence of certification thirty (30) days before commencing work on project.
      b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test. This shall be done at no cost to Owner. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.
   2. Pipe Installers:
      a. Polyethylene pipe installers shall be properly trained and certified in procedure for joining polyethylene pipe.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Do not store polyethylene pipe so it is exposed to sunlight.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Manufacturer Contact List:
   a. BrassCraft, Novi, MI www.brasscraft.com.
   b. Cimberio Valve Co Inc, Malvern, PA www.cimberio.com.
   c. ConBraCo Industries, Inc, Matthews, NC www.conbraco.com or ConBraCo / Honeywell Ltd, Scarborough, ON (416) 293-8111.
   d. Dormont Manufacturing Company, Export, PA www.dormont.com.
   e. Jenkins-NH-Canada, Brantford, ON www.jenkins-nh-canada.com.
   f. Jomar International, Madison Heights, MI www.jomar.com.
   g. California Valves (formally KOSO) by Pacific Seismic Products Inc, Lancaster, CA, Distributed by Strand Earthquake Consultants www.strandearthquake.net.
   h. Watts Regulator Co, North Andover, MA www.wattsreg.com or Watts Industries (Canada) Inc, Burlington, ON (888) 208-8927.

B. Materials:
1. Above-Ground Pipe And Fittings:
   a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of A53/A53M.
   b. Welded forged steel fittings meeting requirements of ASTM A234/A234M or standard weight malleable iron screwed.
2. Below-Ground Pipe And Fittings: Polyethylene pipe and fittings meeting requirements of ASTM D2513 with No. 14 coated copper trace wire.
3. Valves:
   a. 125 psi (862 kPa) bronze body ball valve, UL listed.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) CIM 102.1 by Cimbrio Valve.
      2) Apollo Series 80-100 by ConBraCo.
      3) 'Red Cap' R602 by Jenkins NH Canada.
      4) Model T-204 by Jomar International.
      5) Model B-6000-UL by Watts Regulator.
4. Cocks:
   a. Gauge Cocks: Conbraco Series 50-56 bronze gauge cock.
5. Flexible Connector:
   a. Type 304 stainless steel corrugated tube coated for corrosion protection.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Dormont Supr-Safe.
      2) BrassCraft Procoat.
6. Seismic Valves:
   a. Natural gas seismic shut-off valves.
      1) Rate at maximum 20 psi (138 kPA) pressure with positive seating from minus 40 deg F to plus 150 deg F (minus 40 deg C to plus 66 deg C) for exterior mounting near gas meter.
      2) UL listed valve, factory set for IBC Seismic Design Category D, E, or F.
      3) Size to be determined by total cu ft (0.028 cu m) per hour gas flow requirement of building and following conditions: 0.1 inch (2.54 mm) water column maximum allowable pressure-drop through valve with available pressure of 4 oz (113 grams).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel pipe installed through air plenums, in walls, and pipes 2-1/2 inches (64 mm) and larger shall have welded fittings and joints. Other steel pipe may have screwed or welded fittings.

B. Lay underground pipe in accordance with Manufacturer's recommendations and local gas utility company regulations and specifications.
   1. Provide 24 inch (610 mm) minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of polyethylene line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
   2. Place tracer wire along side of polyethylene pipe from meter to point where pipe rises inside building.
   3. Place 4 inches (100 mm) of sand around gas line buried underground.
   4. Do not install gas piping under building floor slabs-on-grade.

C. On lines serving gas-fired equipment, install gas cocks adjacent to equipment outside of equipment cabinet and easily accessible.

D. Install 6 inch (150 mm) long minimum dirt leg, with pipe cap, on vertical gas drop serving each gas-fired equipment unit.

E. Use fittings for changes of direction in pipe and for branch runouts.

F. Install seismic valve in 24 inch (610 mm) long pipe section anchored to building wall at each end.

3.2 FIELD QUALITY CONTROL

A. Field tests:
   1. Subject all portions of gas piping system, in sections or in entirety, to air pressure of 75 psig (0.52 MPa) and prove airtight for 4 hours.
   2. Disconnect equipment not suitable for 75 psig (0.52 MPa) pressure from piping system during test period.

END OF SECTION

SECTION 23 2300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:

C. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 0719: 'Refrigerant Piping Insulation'.
   3. Section 23 6213: 'Packaged Air-Cooled Refrigerant Compressor And Condenser Units'.
   4. Section 23 8216.01: 'Air Coils: DX'.

1.2 REFERENCES

A. Association Publications:
   1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
      a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
   2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
      a. VISCMA 101-15, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
      b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:
   1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
   2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 5-2013 (packaged w/ 34-2013, 'Safety Standard and Designation and Classification of Refrigerants'.
   2. American National Standards Institute / American Welding Society:
      a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
   3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. 2011 ASHRAE Handbook - HVAC Applications.
         1) Chapter 48, 'Noise and Vibration Control'.
   4. ASTM International:
      a. ASTM A36/A36M-14, 'Standard Specification for Carbon Structural Steel'.
      b. ASTM B280-13, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Show each individual equipment and piping support.

B. Informational Submittals:
   1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Refrigerants:
      a. Underwriters Laboratories / Underwriters Laboratories of Canada:
         1) Comply with requirements of UL 2182.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
   1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Airtec, Fall River, MA, www.noventcaps.com.
      b. Cooper Industries, Houston, TX www.cooperindustries.com.
      c. Cush-A-Clamp by ZSI Manufacturing, Canton, MI www.cushaclamp.com.
      d. Elkhart Products Corp, Elkhart, IN www.elkhartproducts.com.
      e. Emerson Climate Technologies, St Louis, MO www.emersonflowcontrols.com.
      f. Handy & Harman Products Division, Fairfield, CT www.handy-1.com.
      g. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
      h. Henry Valve Co, Melrose Park, IL www.henrytech.com.
      i. Hilti Inc, Tulsa, OK www.hilti.com.
      j. Hydra-Zorb Co, Auburn Hills, MI www.hydra-zorb.com.
      k. JB Industries, Aurora, IL www.jbind.com.
      l. Mueller Steam Specialty, St Pauls, NC www.muellersteam.com.
      m. Nibco Inc, Elkhart, IN www.nibco.com.
      n. Packless Industries, Waco, TX www.packless.com.
      o. Parker Corp, Cleveland, OH www.parker.com.
      p. Sporlan Valve Co, Washington, MO www.sporlan.com.
      q. Sherwood Valves, Washington, PA www.sherwoodvalve.com.
      r. Thomas & Betts, Memphis, TN www.superstrut.com.
      s. Unistrut, Div of Atkore International, Inc., Harvey, IL www.unistrut.com.
      t. Universal Metal Hose, Chicago, IL www.universalmetalhose.com.
      u. Vibration Mountings & Controls, Bloomingdale, NJ www.vmc-kdc.com.
      v. Virginia KMP Corp, Dallas, TX www.virginiakmp.com.

B. Materials:
   1. Refrigerant Piping:
      a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
      b. Do not use pre-charged refrigerant lines.
   2. Refrigerant Fittings:
      a. Wrought copper with long radius elbows.
      b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:

1) Mueller Streamline.
2) Nibco Inc.
3) Elkhart.

3. Tee Access:
   a. Brass:
      1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
4. Connection Material:
   a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
      1) Copper to Copper Connections:
         a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
         b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
      2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
      3) Do not use rods containing Cadmium.
   b. Flux:
      1) Type Two Acceptable Products:
         a) Stay-Silv White Brazing Flux by Harris Products Group.
         b) High quality silver solder flux by Handy & Harmon.
         c) Equal as approved by Architect before use. See Section 01 6200.
5. Valves:
   a. Expansion Valves:
      1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
      2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
      3) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         a) Emerson Climate Technologies.
         b) Henry.
         c) Mueller.
         d) Parker.
         e) Sporlan.
   b. Manual Refrigerant Shut-Off Valves:
      1) Ball valves designed for refrigeration service and full line size.
      2) Valve shall have cap seals.
      3) Valves with hand wheels are not acceptable.
      4) Provide service valve on each liquid and suction line at compressor.
      5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
      6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
         a) Henry.
         b) Mueller.
         c) Sherwood.
         d) Virginia.
6. Filter-Drier:
   a. On lines 3/4 inch (19 mm) outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
   b. On lines smaller than 3/4 inch (19 mm) outside diameter, filter-drier shall be sealed type with brazed end connections.
   c. Size shall be full line size.
   d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      1) Emerson Climate Technologies.
      2) Mueller.
      3) Parker.
      4) Sporlan.
      5) Virginia.
7. Sight Glass:

a. Combination moisture and liquid indicator with protection cap.
b. Sight glass shall be full line size.
c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) HMI by Emerson Climate Technologies.

8. Refrigerant Piping Supports:
a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
b. Securing Channels:
1) At Free-Standing Pipe Support:
a) Class One Quality Standard: P-1000 channels by Unistrut.
b) Acceptable Manufacturers: Hilti, Thomas & Betts.
c) Equal as approved by Architect before installation. See Section 01 6200.
2) At Wall Support:
a) Class One Quality Standard: P-3300 channels by Unistrut.
b) Acceptable Manufacturers: Hilti, Thomas & Betts.
c) Equal as approved by Architect before installation. See Section 01 6200.
3) At Suspended Support:
a) Class One Quality Standard: P-1001 channels by Unistrut.
b) Acceptable Manufacturers: Hilti, Thomas & Betts.
c) Equal as approved by Architect before installation. See Section 01 6200.
4) Angle Fittings:
a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
b) Acceptable Manufacturers: Hilti, Thomas & Betts.
c) Equal as approved by Architect before installation. See Section 01 6200.
c. Pipe Clamps:
1) Type Two Acceptable Manufacturers:
a) Hydra-Zorb.
b) ZSI Cush-A-Clamp.
c) Hilti Cush-A-Clamp.
d) Equal as approved by Architect before installation. See Section 01 6200.

9. Locking Refrigerant Cap:
a. Provide and install on charging valves:
1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
2) Acceptable Manufacturers: Airtec.
3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refrigerant Lines:
1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters).

B. Connections:
1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Specialties:
1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.

3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.

D. Refrigerant Supports:
1. Support Spacing:
a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
c. Support each elbow.
2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:
1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

SECTION 23 2350

REFRIGERANT PIPE COVER

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings, General Provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, and Section 23 0501 apply to this Section.

PART 2 - PRODUCTS

2.1 BASIC COVER

A. Basic refrigerant line cover shall be 18 gauge steel, hot-dipped galvanized steel meeting the requirements of ASTM<A361-85.

B. Pop rivit attachments will not be allowed.

C. All fastening devices shall be plated screws. Arrange covers so they may be taken apart for service.

2.2 MANUFACTURED OUTER COVER

A. Refrigerant line covers at exterior walls shall be 24 ga steel, hot-dipped galvanized meeting requirements of ASTM<A361-85, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process for Roofing and Siding", 1.25 oz/sq ft and complete with accessories recommended by Manufacturer for proper installation.
   1. Approved Manufacturers –
      a. AEP / Span, Dallas, TX or San Diego, CA
      b. Idose Aluminum Products, Allentown, PA
      c. Berridge Manufacturing Co., Houston, TX
      d. Copper Sales Inc., Minneapolis, MN
      e. Engineered Components Inc., Stafford (Houston), TX
      f. Fashion Inc., Lenaxa, KS
      g. Alumax Building Specialties, Mesquite, TX
      h. MM Systems Corp., Tucker, GA
      i. Merchant & Evans Industries Inc., Burlington, NJ
      j. Reynolds Metals Company, Richmond VA

B. Finish:
   1. Fluoropolymer Resin-base finish for coil coating components. Thermo cured two coat system consisting of primer and top coat factory applied over properly pretreated metal.
   2. Color as selected by Engineer from Manufacturer's standard colors.
   3. Approved Manufacturers –
      a. Equal to Duranar 200 by PPG or Fluropon by Desoto containing 70% minimum Kynar 500 by Pennwalt Corp.

PART 3 - INSTALLATION

A. Do not use pop rivets. All fastening devices shall be plated screws and arranged so covers may be taken off for service.

B. Provide access opening for viewing the sight glass on the refrigerant line.

END OF SECTION

SECTION 23 2600

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:
   1. Condensate Drains:
      a. Schedule 40 PVC for condensate drains from furnace combustion chambers and furnace cooling coils.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensate Drains:
   1. Support piping and protect from damage.
   2. Do not combine PVC condensate drain piping from furnace combustion chamber with copper condensate drain piping from cooling coil.

END OF SECTION

SECTION 23 3001

COMMON DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General procedures and requirements for ductwork.
   2. Repair leaks in ductwork, as identified by duct testing, at no additional cost to Owner.

B. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, and Balancing' for ductwork.
   2. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustic sealant.
   3. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
      a. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (Third Edition).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data: Specification data on sealer and gauze proposed for sealing ductwork.
   2. Samples: Sealer and gauze proposed for sealing ductwork.

B. Informational Submittals:
   1. Manufacturer Instructions:
      a. Installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
   1. Design Criteria:
      a. Standard Ducts: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible'.

B. Materials:
   1. Duct Hangers:

a. One inch (25 mm) by 18 ga (1.27 mm) galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches (2 400 mm) apart. Do not use wire hangers.
b. Attaching screws at trusses shall be 2 inch (50 mm) No. 10 round head wood screws. Nails not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
1. Install pair of hangers as required by spacing indicated in table on Drawings.
2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION

SECTION 23 3114

LOW-PRESSURE METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install above-grade low-pressure steel ducts and related items as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:
   1. Duct smoke detectors.

C. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, And Balancing' for duct test, balance, and adjust air duct systems services provided by Owner.
   2. Section 23 0713: 'Duct Insulation' for thermal Insulation for ducts, plenum chambers, and casings.
   3. Section 23 3001: 'Common Duct Requirements'.
   4. Section 23 0933: ‘Electric And Electronic Control System For HVAC':
      a. Temperature control damper actuators and actuator linkages.
      b. Furnishing of duct smoke detectors.

1.2 REFERENCES

A. Association Publications:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
   2. SMACNA, ‘HVAC Duct Construction Standards - Metal and Flexible' (Third Edition).

B. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-13, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM E84-14, ‘Standard Test Method for Surface Burning Characteristics of Building Materials'.
   2. Underwriters Laboratories, Inc.:
      a. UL 723: ‘Standard for Safety Test for Surface Burning Characteristics of Building Materials'; (2010 - Tenth Edition).

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Duct Sealer:
      a. Meet Class A flame spread rating in accordance with ASTM E84 or UL 723.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Duct Sealer:

a. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).
b. Handle to prevent inclusion of foreign matter, damage by water, or breakage.
c. Store in a cool dry location, but never under 35 deg F (1.7 deg C) or subjected to sustained temperatures exceeding 110 deg F (43 deg C) or as per Manufacturer's written recommendations.
d. Do use sealants that have exceeded shelf life of product.

1.5 FIELD CONDITIONS

A. Ambient Conditions:
1. Duct Sealer:
a. Do not apply under 35 deg F (1.7 deg C) or subjected to sustained temperatures exceeding 110 deg F (43 deg C) or as per Manufacturer's written recommendations.
b. Do not apply when rain or freezing temperatures will occur within seventy two (72) hours.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
1. Sheet Metal:
a. Fabricate ducts, plenum chambers and casings of zinc-coated, lock-forming quality steel sheets meeting requirements A653/A653M, with G 60 coating.
2. Duct Sealer For Interior Ducts:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Duct Butter or ButterTak by Cain Manufacturing Co Inc, Pelham, AL www.cainmfg.com.
2) DP 1010 by Design Polymerics, Fountain Valley, CA www.designpoly.com.
3) PROseal, FIBERseal, EVERseal, or EZ-seal by Ductmate Industries, Inc., Charleroi, PA www.ductmate.com.
4) SAS by Duro Dyne, Bay Shore, NY or Duro Dyne Canada, Lachine, QB www.durodyne.com.
5) Iron Grip 601 by Hardcast Inc, Wylie, TX www.hardcast.com.
6) MTS100 or MTS 200 by Hercules Mighty Tough, Denver CO, www.herculesindustries.com.
7) 15-325 by Miracle / Kingco, Div ITW TACC, Rockland, MA www.taccint.com.
8) 44-39 by Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
9) Airseal Zero by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.
10) Airseal #22 Water Base Duct Sealer by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.

B. Fabrication:
1. General:
a. Straight and smooth on inside with joints neatly finished.
b. Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck. Drops shall be same gauge as branch duct. Seal joints air tight.
2. Standard Ducts:
a. General:
1) Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
b. Rectangular Duct:
1) Duct panels through 48 inch (1 200 mm) dimension having acoustic duct liner need not be cross-broken or beaded. Cross-break unlined ducts, duct panels larger than 48 inch

(1 200 mm) vertical and horizontal sheet metal barriers, duct offsets, and elbows, or bead 12 inches (300 mm) on center.
a) Apply cross-breaking to sheet metal between standing seams or reinforcing angles.
b) Center of cross-break shall be of required height to assure surfaces being rigid.
c) Internally line square and rectangular drops. Externally insulate round drops.

c. Round Duct:
1) Spiral Seam:
a) 28 ga (0.38 mm) minimum for ducts up to and including 14 inches (355 mm) in diameter.
b) 26 ga (0.46 mm) minimum for ducts over 14 inches (355 mm) and up to and including 26 inches (660 mm) in diameter.
2) Longitudinal Seam:
a) 28 ga (0.38 mm) minimum for ducts up to and including 8 inches (200 mm) in diameter.
b) 26 ga (0.46 mm) minimum for ducts over 8 inches (200 mm) and up to 14 inches (355 mm) in diameter.
c) 24 ga (0.61 mm) minimum for ducts over 14 inches (355 mm) up to and including 26 inches (660 mm) in diameter.

PART 3 - EXECUTION

3.1 PREPARATION

A. Metal duct surface must be clean and free of moisture, contamination and foreign matter before applying duct sealer for interior and exterior ducts.

3.2 INSTALLATION

A. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer as per Manufacturer's written instructions. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.

B. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.

C. Ducts shall not bear on top of structural members.

D. Paint ductwork visible through registers, grilles, and diffusers flat black.

E. Properly flash where ducts protrude above roof.

F. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Air Test and Balance Testing as specified in Section 01 4546: 'Duct Testing, Adjusting, and Balancing'.

B. Non-Conforming Work:
1. Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures at no additional cost to Owner.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for temperature control damper actuators and actuator linkages.
   2. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-15, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM C1071-12, 'Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)'.
      c. ASTM C1338-14, 'Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings'.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. AGM Industries, Brockton, MA www.agmind.com.
      b. Air Balance Inc, Holland, OH www.airbalance.com.
      c. Air Filters Inc, Baltimore, MD www.afinc.com.
      d. Air-Rite Manufacturing, Bountiful, UT (801) 295-2529.
      e. American Warming & Ventilating, Holland, OH www.american-warming.com.
      f. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
      g. Cain Manufacturing Company Inc, Pelham, AL www.cainmfg.com.
      h. C & S Air Products, Fort Worth, TX www.csairproducts.com.
      i. CertainTeed Corp, Valley Forge, PA www.certainteed.com.
      j. Cesco Products, Florence, KY www.cescoproducts.com.
      k. Daniel Manufacturing, Ogden, UT (801) 622-5924.
      l. Design Polymerics, Fountain Valley, CA www.designpoly.com.
      m. Ductmate Industries Inc, East Charleroi, PA www.ductmate.com.
      n. Duro Dyne, Bay Shore, NY www.durodyne.com.
      o. Dyn Air Inc. Lachine, QB www.dynair.ca
      p. Elgen Manufacturing Company, Inc. East Rutherford, NJ www.elgenmfg.com
      q. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com.
      r. Greenheck Corp, Schofield, WI www.greenheck.com.
      s. Gripnail Corp, East Providence, RI www.gripnail.com.
      t. Hardcast Inc, Wylie, TX www.hardcast.com.

u. Hercules Industries, Denver, CO, www.herculesindustries.com.
v. Honeywell Inc, Minneapolis, MN www.honeywell.com.
w. Industrial Acoustics Co, Bronx, NY www.industrialacoustics.com.
x. Johns-Manville, Denver, CO www.jm.com.
y. Kees Inc, Elkhart Lake, WI www.kees.com.
z. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com.
aa. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
bb. Metco Inc, Salt Lake City, UT (801) 467-1572 www.metcospiral.com.
cc. Miracle / Kingco, Rockland, MA www.taccint.com.
dd. Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
ee. Nailor Industries Inc, Houston, TX www.nailor.com.
ff. Owens Corning, Toledo, OH www.owenscorning.com.
gg. Polymer Adhesive Sealant Systems Inc, Irving, TX www.polymeradhesives.com.
hh. Pottorff Company, Fort Worth, TX www.pottorff.com.
ii. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
jj. Sheet Metal Connectors Inc, Minneapolis, MN www.smconnectors.com.
kk. Tamco, Stittsville, ON www.tamco.ca.
ll. Techno Adhesive, Cincinnati, OH www.technoadhesives.com.
mm. Titus, Richardson, TX (972) 699-1030. www.titus-hvac.com
nn. McGill AirSeal, Columbus, OH www.mcgillairseal.com.
oo. United Enertech Corp, Chattanooga, TN www.unitedenertech.com.
pp. Utemp Inc, Salt Lake City, UT (801) 978-9265.
qq. Ventfabrics Inc, Chicago, IL www.ventfabrics.com.
rr. Ward Industries, Grand Rapids MI www.wardind.com.
ss. Young Regulator Co, Cleveland, OH www.youngregulator.com.

B. Materials:
1. Acoustical Liner System:
a. Duct Liner:
1) One inch (25 mm) thick, 1-1/2 lb (0.68 kg) density fiberglass conforming to requirements of ASTM C1071. Liner will not support microbial growth when tested in accordance with ASTM C1338.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) ToughGard by CertainTeed.
b) Duct Liner E-M by Knauf Fiber Glass.
c) Akousti-Liner by Manson Insulation.
d) Quiet R by Owens Corning.
e) Linacoustic RC by Johns-Manville.
b. Adhesive:
1) Category Four Approved Water-Based Products. See Section 01 6200 for definitions of Categories:
a) Cain: Hydrotak.
b) Design Polymerics: DP2501 or DP2502 (CMCL-2501).
c) Duro Dyne: WSA.
d) Elgen: A-410-WB.
e) Hardcast: Coil-Tack.
f) Hercules: Mighty Tough Adhesives MTA500 or MTA600.
g) Miracle / Kingco: PF-101.
h) Mon-Eco: 22-67 or 22-76.
i) Polymer Adhesive: Glasstack #35.
j) Techno Adhesive: 133.
k) McGill AirSeal: Uni-tack.
2) Category Four Approved Solvent-Based (non-flammable) Products. See Section 01 6200 for definitions of Categories:
a) Cain: Safetak.
b) Duro Dyne: FPG.
c) Hardcast: Glas-Grip 648-NFSE.
d) Miracle / Kingco: PF-91.
e) Mon-Eco: 22-24.
f) Polymer Adhesive: Q-Tack.

g) Techno Adhesive: 'Non-Flam' 106.

3) Category Four Approved Solvent-Based (flammable) Products. See Section 01 6200 for definitions of Categories:
   a) Cain: HV200.
   b) Duro Dyne: MPG.
   c) Hardcast: Glas-Grip 636-SE.
   d) Miracle / Kingco: PF-96.
   e) Mon-Eco: 22-22.
   f) Polymer Adhesive: R-Tack.
   g) Techno Adhesive: 'Flammable' 106.

c. Fasteners:
   1) Adhesively secured fasteners not allowed.
   2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a) AGM Industries: 'DynaPoint' Series RP-9 pin.
      b) Cain.
      c) Duro Dyne.
      d) Gripnail: May be used if each nail is installed by 'Grip Nail Air Hammer' or by 'Automatic Fastener Equipment' in accordance with Manufacturer's recommendations.

2. Flexible Equipment Connections:
   a. 30 oz closely woven UL approved glass fabric, double coated with neoprene.
   b. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 200 deg F (93 deg C).
   c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) Cain: N-100.
      2) Duro Dyne: MFN.
      3) Dyn Air: CPN with G-90 galvanized off-set seam.
      4) Elgen: ZLN / SDN.
      5) Ventfabrics: Ventglas.
      6) Ductmate: ProFlex.
3. Duct Access Doors:
   a. General:
      1) Factory built insulated access door with hinges and sash locks, as necessary. Construction shall be galvanized sheet metal, 24 ga (0.635 mm) minimum.
      2) Fire and smoke damper access doors shall have minimum clear opening of 12 inches (300 mm) square or larger as shown on Drawings.
   b. Rectangular Ducts:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Air Balance: Fire*/*Seal FSA 100.
         b) Air-Rite: Model HAD-2.
         c) Cesco: HDD.
         d) Elgen: TAB Type / Hinge and Cam.
         e) Flexmaster: Spin Door.
         f) Kees: ADH-D.
         g) Nailor: 08SH.
         h) Pottorff: 60-HAD.
         i) Ruskin: ADH-24.
         j) United Enertech: L-95.
   c. Round Ducts:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) Ductmate: ‘Sandwich’ Access Door.
         b) Elgen: Sandwich Access Door.
         c) Kees: ADL-R.
         d) Nailor: 0809.
         e) Pottorff: RAD.
         f) Ruskin: ADR.
         g) Ward: DSA.
4. Dampers And Damper Accessories:
   a. Locking Quadrant Damper Regulators:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Duro Dyne: KS-385.
b) Dyn Air: QPS-385.
c) Elgen: EQR-4.
d) Ventfabrics: Ventline 555.
e) Young: No. 1.

b. Concealed Ceiling Damper Regulators:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Cain.
b) Duro Dyne.
c) Elgen.
d) Metco Inc.
e) Ventfabrics: 666 Ventlok.
f) Young: 301.

c. Volume Dampers:
1) Rectangular Duct:
a) Factory-manufactured 16 ga (1.6 mm) galvanized steel, single blade and opposed blade type with 3/8 inch (9.5 mm) axles and end bearings. Blade width 8 inches (200 mm) maximum. Blades shall have 1/8 inch (3 mm) clearance all around.
b) Damper shall operate within acoustical duct liner.
c) Provide channel spacer equal to thickness of duct liner.
d) Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, furnish with concealed ceiling damper regulator and cover plate.
e) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air-Rite: Model CD-2.
(2) American Warming: VC-2-AA.
(3) Arrow: OBDAF-207.
(4) C & S: AC40.
(5) Cesco: AGO.
(6) Daniel: CD-OB.
(7) Greenheck: VCD-20.
(8) Nailor: 1810 or 1820.
(9) Pottorff: CD-42.
(10) Ruskin: MD-35.
(11) United Enertech: MD-115.
(12) Utemp: CD-OB.
2) Round Duct:
a) Factory-manufactured 20 ga (1.0 mm) galvanized steel, single blade with 3/8 inch (9.5 mm) axles and end bearings.
b) For use in outside air ducts.
c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: Model AC-22.
(2) Air-Rite: Model CD-5.
(3) American Warming: V-22.
(4) Arrow: Type-70.
(5) C & S: AC21R.
(6) Cesco: MGG.
(7) Nailor: 1890.
(8) Pottorff: CD-21R.
(9) Ruskin: MDRS-25.
(10) United Enertech: RD.

d. Motorized Outside Air Dampers:
1) General:
a) Low leakage type. AMCA certified.
b) Make provision for damper actuators and actuator linkages to be mounted external of air flow.
2) Rectangular Ducts:
a) Damper Blades:

(1) Steel or aluminum airfoil type with mechanically locked blade seals, 8 inch (200 mm) blade width maximum measured perpendicular to axis of damper.
(2) Jamb seals shall be flexible metal compression type.
(3) Opposed or single blade type.

b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: AC 526.
(2) American Warming: AC526.
(3) Arrow: AFD-20.
(4) C & S: AC50.
(5) Cesco: AGO3.
(6) Nailor: 2020.
(7) Pottorff: CD-52.
(8) Ruskin: CD-60.
(9) Tamco: Series 1000.
(10) United Enertech: CD-150 or CD-160.

3) Round Ducts:
a) Damper Blades:
(1) Steel with mechanically locked blade seals.
(2) Blade seals shall be neoprene or polyethylene.
(3) Single blade type.

b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
(1) Air Balance: AC 25.
(2) American Warming: VC25.
(3) Arrow: Type 70 or 75.
(4) C & S: AC25R.
(5) Cesco: AGG.
(6) Nailor: 1090.
(7) Pottorff: CD-25R.
(8) Ruskin: CD25.
(9) Tamco: Square-to-Round Series 1000.
(10) United Enertech: RI.

e. Backdraft Dampers:
1) Backdraft blades shall be nonmetallic neoprene coated fiberglass type.
2) Stop shall be galvanized steel screen or expanded metal, 1/2 inch (13 mm) mesh.
3) Frame shall be galvanized steel or extruded aluminum alloy.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Air-Rite: Model BDD-3.
b) American Warming: BD-15.
c) C & S: BD30.
d) Pottorff: BD-51.
e) Ruskin: NMS2.
f) Utemp: BFEA.

5. Air Turns:
a. Single thickness vanes. Double thickness vanes not acceptable.
b. 4-1/2 inch (115 mm) wide vane rail. Junior vane rail not acceptable.

6. Branch Tap for Flexible Ductwork:
a. Factory-manufactured rectangular-to-round 45 degree leading tap fabricated of 24 ga (0.635 mm) zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A653, with G-90 coating.
b. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
c. Manual Volume Damper:
1) Single blade, 22 ga (0.79 mm) minimum
2) 3/8 inch (9.5 mm) minimum square rod with brass damper bearings at each end.
3) Heavy-duty locking quadrant on 1-1/2 inch (38 mm) high stand-off mounting bracket attached to side of round duct.
d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:

1) ST-1HD by Air-Rite.
2) STO by Flexmaster.
3) HET by Sheet Metal Connectors.

C. Fabrication:
1. Duct Liner:
a. Install mat finish surface on airstream side. Secure insulation to cleaned sheet metal duct with continuous 100 percent coat of adhesive and with 3/4 inch (19 mm) long mechanical fasteners 12 inches (300 mm) on center maximum unless detailed otherwise on Drawings. Pin all duct liner.
b. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation shall overlap sides. If liner is all one piece, folded corners shall be tight against metal. Ends shall butt tightly together.
c. Coat longitudinal and transverse edges of liner with adhesive.
2. Air Turns:
a. Permanently install vanes arranged to permit air to make abrupt turn without appreciable turbulence, in 90 degree elbows of above ground supply and return ductwork.
b. Quiet and free from vibration when system is in operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Liner:
1. Furnish and install acoustic lining in following types of rectangular ducts unless noted otherwise on Contract Documents:
a. Supply air.
b. Return air.
c. Mixed air.
d. Transfer air.
e. Relief air.
f. Elbows, fittings, and diffuser drops greater than 12 inches (300 mm) in length.
2. Do not install acoustic lining in round ducts.

B. Flexible Connections: Install flexible inlet and outlet duct connections to each furnace.

C. Access Doors In Ducts:
1. Install at each manual outside air damper and at each motorized damper. Locate doors within 6 inches (150 mm) of installed dampers.
2. Install within 6 inches (150 mm) of fire dampers and in Mechanical Room if possible. Install on side of duct that allows easiest access to damper.

D. Dampers And Damper Accessories:
1. Install concealed ceiling damper regulators.
a. Paint cover plates to match ceiling tile.
b. Do not install damper regulators for dampers located directly above removable ceilings or in Mechanical Rooms.
2. Provide each take-off with an adjustable volume damper to balance that branch.
a. Anchor dampers securely to duct.
b. Install dampers in main ducts within insulation.
c. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
d. Where concealed ceiling damper regulators are installed, provide cover plate.
3. Install motorized dampers.

END OF SECTION

SECTION 23 3346

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: Common Duct Requirements.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
   2. Underwriters Laboratories:
      a. UL 181, 'Factory-Made Ducts and Air Connectors' (10th Edition).
      b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. JP Lamborn Co., Fresno CA www.jplflex.com.
      b. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com or Flexmaster Canada Ltd, Richmond Hill, ON (905) 731-9411.
      c. Thermaflex by Flexible Technologies, Abbeville, SC or Mississauga, ON www.thermaflex.net.

B. Materials:
   1. Ducts:
      a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
      b. Insulation:
         1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
      c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
      d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) PR-25 by JP Lambornes.
         2) Flex-Vent KP by Thermaflex by Flexible Technologies.
         3) Type 1B Insulated by Flexmaster.

2. Cinch Bands: Nylon, 3/8 inch (9.5 mm) removable and reusable type.
   a. Listed and labeled in accordance with Standard UL 181B and labeled 'UL 181 B-C'.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct in fully extended condition free of sags and kinks, using 72 inch (1 800 mm) maximum lengths.

B. Make duct connections by coating exterior of duct collar for 3 inches (75 mm) with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 3401

EXHAUST FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install exhaust fans as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.
   2. Division 26: Control device and electrical connection.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Bear AMCA seal and UL label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Acme Engineering & Manufacturing Corp, Muskogee, OK www.acmefan.com.
   2. Broan-Nu Tone LLC, Harford, WI www.broan.com.
   3. Carnes Co., Verona, MI www.carnes.com.
   4. Loren Cook Co., Springfield, MO www.lorencook.com.
   5. Soler & Palau (S&P USA Ventilation Systems, LLC), Jacksonville FL www.solerpalau-usa.com.

2.2 MANUFACTURED UNITS

A. Ceiling Mounted Exhaust Fans:
   1. Acoustically insulated housings. Sound level rating of 5.0 sones maximum for CFM and static pressure listed on Contract Drawings.
   2. Include chatterproof integral back-draft damper with no metal-to-metal contact.
   3. True centrifugal wheels.
   4. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.
   5. Suitably ground motors and mount on rubber-in shear vibration isolators.
   6. Provide wall or roof cap, as required.
   7. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Acme: VQ.
      b. Broan: LoSone.
      c. Carnes: VCD.
      d. Cook: Gemini.
      e. Soler & Palau: FF.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor fan units securely to structure or to curb.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'General Duct Requirements'.

1.2 SUBMITTALS

A. Maintenance Material Submittals:
   1. Tools: Leave tool for removing core of each different type of grille for building custodian.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Carnes Co, Verona, MI www.carnes.com.
   2. J & J Register, Grand Rapids, MI www.jandjreg.com.
   3. Krueger Air System Components, Richardson, TX www.krueger-hvac.com.
   4. Nailor Industries Inc, Houston, TX or Weston, ON www.nailor.com.
   5. Price Industries Inc, Suwanee, GA www.price-hvac.com or E H Price Ltd, Winnipeg, MB (204) 669-4220.
   6. Titus, Richardson, TX www.titus-hvac.com.
   7. Tuttle & Bailey, Richardson, TX www.tuttleandbailey.com.

2.2 MANUFACTURED UNITS

A. Hard Ceiling Diffusers:
   1. Finish: Off-white baked enamel.
   2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Carnes: SKSA.
      b. Krueger: SH Frame F21.
      c. Price: SMD.
      d. Titus: TDC Border Type 6.
      e. Tuttle & Bailey: MS.

B. Ceiling Return And Transfer Grilles:
   1. Finish: Off-white baked enamel.
   2. 1/2 inch (12.7 mm) spacing.
   3. See Contract Documents for location of filter grilles.
   4. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Carnes: RSLA.
      b. J & J: S90H.

c. Krueger: S85H.
d. Nailor: 6155H.
e. Price: 535.
f. Titus: 355RL or 355 RS.
g. Tuttle & Bailey: T75D.

C. High Side Wall Return Grilles:
1. Finish: Off-white baked enamel.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Krueger: 5810.
b. Nailor: 51RC.
c. Price: RCG.
d. Titus: 1700.
e. Tuttle & Bailey: AVF.

D. Side Wall Supply Grilles And Registers:
1. Finish: Off-white baked enamel.
2. Removable core.
3. Double deflection.
4. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Krueger: 5815.
b. Nailor: 51RCD.
c. Price: RCG-DVS.
d. Titus: 1707.
e. Tuttle & Bailey: AVF.

E. Low Sidewall Return Grilles:
1. Finish: Off-white baked enamel.
2. 38 or 45 degree deflection.
3. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Carnes: RSHA.
b. J & J: S-590.
c. Krueger: S480H.
d. Nailor: 6145H-HD.
e. Price: 91.
f. Titus: 33RL or 33RS.
g. Tuttle & Bailey: T115D.

F. Ceiling Diffusers:
1. Finish: Off-white baked enamel.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Carnes: SKSA.
b. J & J: R-1400.
c. Krueger: SH.
d. Nailor: 65OOB.
e. Price: SMD-6.
f. Titus: TDC-6.
g. Tuttle & Bailey: M.

G. Soffit Grilles:
1. Finish: Baked enamel. Match soffit color.
2. Aluminum with aluminum mesh insect screen.
3. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Carnes: RAAA.
b. J & J: ALS95H.
c. Krueger: S585H.
d. Metal*Aire: RHE.
e. Nailor: 5155-IS.
f. Price: 635.
g. Titus: 355FL.

h. Tuttle & Bailey: A75D.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side. Level floor registers and anchor securely into floor.

3.2 ADJUSTING

A. Set sidewall supply register blades at 15 degrees upward deflection.

END OF SECTION

SECTION 23 3714

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install louvers connected to ductwork as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Architectural louvers not connected to ductwork.

C. Related Requirements:
   1. Section 06 2001: 'Common Finish Carpentry Requirements' for installation of architectural louvers not connected to ductwork.
   2. Section 23 3001: 'General Duct Requirements'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Airolite Co, Marietta, OH www.airolite.com.
   2. Air-Rite Manufacturing, Bountiful, UT www.air-ritemfg.com.
   3. American Warming & Ventilating, Holland, OH www.awv.com.
   4. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
   5. Carnes Co, Verona, WI www.carnes.com or Energy Technology Products LTD, Edmonton, AB (780) 468-1110.
   6. Industrial Louvers Inc, Delano, MN www.industriallouvers.com or DKG Construction, LTD., Waterdown, ON 289-895-9729.
   7. Pottorff, Fort Worth, TX www.pottorff.com.
   8. Ruskin Manufacturing, Kansas City. MO www.ruskin.com.
   9. United Enertech Corporation, Chattanooga, TN www.unitedenertech.com.
   10. Vent Products Co Inc, Chicago, IL www.ventprod.com.
   11. SF435 by Western Ventilation Products Ltd, Calgary, AB www.westvent.com.
   12. Wonder Metals Corp, Redding, CA www.wondermetals.com.

2.2 MANUFACTURED UNITS

A. Louvers:
   1. General:
      a. Extruded aluminum, with blades welded or screwed into frames.
      b. Frames shall have mitered corners.
      c. Louvers shall be recessed, flanged, stationary, or removable as noted on Contract Documents.
      d. Finish:
         1) Polyvinyledene Fluoride (PVF_2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF_2 in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal.
         2) Color as selected by Architect from Manufacturer's standard colors.

2. Louvers Connected To Ductwork:
   a. 1/2 inch (13 mm) mesh 16 ga (1.59 mm) aluminum bird screen.
   b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      1) K638 by Airolite.
      2) LE-1 by Air-Rite Manufacturing.
      3) LE48 by American Warming & Ventilating.
      4) EA-405 by Arrow United Industries.
      5) FKDA by Carnes.
      6) 455-XP by Industrial Louvers.
      7) EFK-445 by Pottorff.
      8) ELF81S30 by Ruskin.
      9) EL-4 by United Enertech.
      10) 2740-31 by Vent Products.
      11) EX by Wonder Metals.
3. Architectural Louvers:
   a. Aluminum bug screen.
   b. Class One Quality Standards:
      1) T608 by Airolite.
      2) LE57 by American Warming & Ventilating.
      3) EFJ-245 by Pottorff.
      4) EL-2 by United Enertech.
      5) Equals by Arrow United Industries, Carnes, or Industrial Louvers as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings.

B. Where louvers touch masonry or dissimilar metals, protect with heavy coat of asphaltum paint.

END OF SECTION

SECTION 23 3723

HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install roof vents as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer List:
   1. Air-Rite Manufacturing, Bountiful, UT (801) 295-2529.
   2. Breidert Air Products, Jacksonville, FL www.breidert.com.
   3. Carnes Company, Verona, WI www.carnes.com.
   4. Greenheck Fan Corporation, Schofield, WI www.greenheck.com.
   5. Loren Cook Co, Springfield, MO www.lorencook.com.
   6. United Enertech Corporation, Chattanooga, TN www.unitedenertech.com.
   7. Vent Products Co, Inc, Chicago, IL www.ventprod.com.

2.2 MANUFACTURED UNITS

A. Louvered Penthouses:
   1. Fabricated from (0.081 inch 2.15 mm) extruded aluminum.
      a. All welded construction.
      b. Screws or rivets will not be allowed.
   2. Blades:
      a. Horizontal at 45 degree angle with return bends at upper edges.
      b. Welded, mitered corners for continuous blade effect.
   3. Bird Screens: 1/2 inch (13 mm) square mesh 16 ga (1.6 mm) aluminum in extruded aluminum, rewirable frames on interior of louvers.
   4. Penthouse Finish: Clear anodized aluminum.
   5. Curbs:
      a. Extruded aluminum, insulated, factory-fabricated curb.
      b. Insulation: Minimum 1-1/2 inches (38 mm) thick, 3 lb 48 kg per cubic m density fiber glass.
      c. Curb Extension: 8 inches (200 mm) above finished roof level.
   6. Provide automatic back draft damper on Relief Air Penthouses. Provide motorized damper where indicated on Drawings.
   7. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      a. Air-Rite Manufacturing: Model LPE-1.
      b. Breidert: Model RLX.
      c. Carnes: GLAB.
      d. Cook: Type TRE.
      e. Greenheck: WIH/WRH.
      f. United Enertech: Model PEL-4.
      g. Vent Products: Model 7100.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 23 4100

AIR FILTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install filters used in mechanical equipment.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 52.2-2012, 'Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size'.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Furnace and ERV Filters: One inch (25 mm) thick throw-away type as recommended by Manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide ample access for filter removal.

3.2 FIELD QUALITY CONTROL

A. Inspection: At date of Substantial Completion, air filters shall be new, clean, and approved by Owner's representative.

END OF SECTION

SECTION 23 5135

AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install heating equipment exhaust piping and combustion air intake piping as described in Contract Documents.

B. Related Requirements:
   1. Section 07 6310: 'Steep Slope Roof Flashing: Asphalt Tile' for pipe flashing used on steep slope asphalt tile roofs only.
   2. Sections Under 09 9000 Heading: Painting.
   3. Section 22 3413: 'Instantaneous, Tankless, Gas Domestic Water Heaters'.
   4. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D1785-12, 'Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.
      b. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
      c. ASTM D2661-11, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'.
      d. ASTM D2665-14, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Armaflex by Armacell, Mebane, NC www.armaflex.com.
      b. Nomaco, Youngsville, NC www.nomacokflex.com.

B. Materials:
   1. Air Piping: Schedule 40 pipe and fittings meeting requirements of ASTM D1785, ASTM D2661, or ASTM D2665.
   2. Piping Primer And Cement:
      a. Meet requirements of ASTM D2564.
   3. Insulation Joint Sealer:
      a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) 520 by Armaflex.
         2) R-320 by Nomaco K-Flex.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation For Condensing Furnaces:
   1. Run individual vent and individual combustion intake piping from each furnace to concentric roof termination kit provided by Furnace Manufacturer. Slope lines downward toward furnace.
   2. Slope combustion chamber drain downward to funnel drain. Anchor to wall with wall clamps, allowing free movement through clamp for expansion.
   3. Use concentric roof termination kit provided by Furnace Manufacturer. Install vent and combustion air intake piping at clearance and distances required by Furnace Manufacturer.
   4. Attach factory-supplied neoprene coupling to combustion-air inlet connection and secure with clamp.
   5. Ensure that factory-supplied perforated metal disc is installed in flexible coupling, unless its removal is required.
   6. York Furnaces: Install air piping on side of furnace in horizontal or vertical installation.

B. Installation For Condensing Water Heaters:
   1. Run individual vent and individual combustion intake piping from each water heater to roof termination as recommended by Water Heater Manufacturer. Concentric roof termination kit may be used if approved by and provided by Water Heater Manufacturer. Slope lines downward toward water heater.
   2. Slope combustion chamber exhaust drain downward to floor drain.

C. Support:
   1. Support concentric roof termination kit at ceiling or roof line with 20 ga (0.912 mm) sheet metal straps as detailed on Drawings.
   2. Support horizontal and sloping sections of pipe with 1 inch (25 mm) wide 20 ga (1.0058 mm) galvanized steel straps. Anchor securely to structure, not allowing pipe to sway.

END OF SECTION

SECTION 23 5417

GAS-FIRED FURNACES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install horizontal/vertical gas-fired condensing furnaces as described in Contract Documents.

B. Related Sections:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 1123: 'Facility Natural Gas Piping'.
   3. Section 23 2300: 'Refrigerant Piping'.
   4. Section 23 4100: 'Air Filters'.
   5. Section 23 5135: ‘Air Piping’.

1.2 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Reports: Equipment check-out sheets.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Warranty.
      b. Record Documentation:
         1) Manufacturers Documentation:
            a) Equipment checkout sheet: Complete and sign all items for each unit.

1.3 WARRANTY

A. Manufacturer’s Warranty:
   1. Provide Manufacturer’s Special LDS Warranty for the following:
      a. Provide fifteen (15) year minimum limited warranty of heat exchanger and five (5) year limited warranty on parts.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturer:
   1. Manufacturer Contact List:
      a. Carrier Corporation:
         1) Carrier National: Doug Masch (317) 370-2727 Doug.Masch@carrier.utc.com.
         2) Carrier Utah: Rich Carpenter (Contractors HVAC Supply) (801) 410-6077 e-mail rcarpent@mtncom.net.
      b. Lennox Industries:
         1) For pricing and information contact Lennox National Account @ 1-800-367-6285.
         2) Lennox National Contact : Cory Hickens (951) 332-3658 cory.hicken@LennoxInd.com.

c. Trane Company:
1) Salt Lake Trane, attention: Jason Bradford (801) 486-0500 www.Jason.Bradford@trane.com.
d. York International:
1) Brian Michael (405) 419-6230 brian.k.michael@jci.com.

B. Performance:
1. Design Criteria:
a. Rated at 92 percent minimum AFUE (Annual Fuel Utilization Efficiency) calculated in accordance with DOE test procedures.

C. Manufactured Units:
1. Furnaces:
a. Factory assembled units certified by CSA complete with blower section, furnace section, steel casing, piped, and wired.
b. Blower section shall consist of cabinet, blower, and motor.
1) Cabinet shall be of 22 ga (0.8 mm) minimum cold rolled steel and have finish coat of baked-on enamel.
2) Blower shall be Class 1, full DIDW, statically and dynamically balanced.
c. Automatic controls shall consist of:
1) Manual gas shut-off valve.
2) Operating automatic gas valve.
3) Solid-state type fan and thermal limit controls.
4) 24-volt transformer.
5) Hot surface ignition system.
d. Blower shall be driven by multi-speed direct driven motor.
e. Furnace section shall be enclosed in 22 ga (0.8 mm) minimum enameled steel casing lined with foil covered insulation.
f. Heat Exchanger: Aluminized steel.
g. Gas Burners: Aluminized steel.
h. PVC intake of outside air and PVC combustion product exhaust, with sealed combustion, direct vent system.
i. Concentric roof termination kit for roof mounting.
j. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Standard Furnaces:
a) Carrier: 59SC5A.
b) Lennox: ML195.
c) Trane: TUX1/TDX1 or TUH1/TDH1.
d) York: TG9S.
2) Two Stage Heat with ECM motor:
a) Carrier: 59TN6.
b) Lennox: EL296V.
c) York: TM9V.
2. Cooling Coil:
a. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match furnace:
1) Coil shall have aluminum fins bonded to seamless copper or aluminum tubing.
2) Coil shall be ARI rated. Provide drain pans with connections at one end.
3) Use thermal expansion valve.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Horizontal:
a) Carrier: CNPHP.
b) Lennox: CH33.
c) Trane: 4TXC.
d) York: MC.
2) Vertical:
a) Carrier: CNPVP.
b) Lennox: CX34.
c) Trane: 4TXC.
d) York: FC.

2.2 ACCESSORIES

A. Filter Frame:
   1. Build filter frame external to furnace as detailed on Drawings.

B. Vibration Isolators:
   1. Horizontal Installation:
      a. Neoprene hanger type with load of 75 lbs (34 kg) maximum.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) RH by Kinetics Noise Control, Dublin, OH www.kineticsnoise.com.
         2) Mason Industries, Hauppage, NY www.mason-ind.com.
         3) RH by Vibration Mounting & Controls, Bloomingdale, NJ www.vmc-kdc.com.
   2. Vertical Installation: 4 inches (100 mm) square by 1/2 inch (13 mm) thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolators:
   1. Install vibration isolator on each hanger rod supporting horizontal furnace and under each corner of vertical furnace.

3.2 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
   1. Manufacturer Services:
      a. Furnace installer shall:
         1) Verify proper gas orifice size.
         2) Clock gas meter for rated input.
         3) Verify and set gas pressure at furnace.
         4) Check and measure temperature rise.
         5) Check safety controls for proper operation.
         6) Check combustion vent sizes and combustion air sizes.
      b. In addition, furnace installer shall start up, check out, and adjust furnaces using equipment check-out sheet provided by Manufacturer. Complete and sign all items on sheet.

END OF SECTION

SECTION 23 6214

COMPRESSOR UNITS: Air Conditioning (5 Ton or less)

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install compressor units as described in contract documents.

B. Related Sections:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 2300: 'Refrigerant Piping'.
   3. Section 23 5417: 'Gas-Fired Furnaces'.

1.2 REFERENCES

A. Definitions:
   1. Compressor: Pump that increases vapor (refrigerant or air) pressure from one level to a higher level of pressure.
   2. Compressor Unit: Outside section of an air conditioning system which pumps vaporized refrigerant from the evaporator, compresses it, liquefies it in the condenser and returns it to the evaporator coil. The outdoor portion of a split system air conditioner contains the compressor and outdoor coil.
   3. Condenser: Device used to condense refrigerant in a cooling system.
   4. Condenser Coils: In a compressor unit, the coil dissipates heat from the refrigerant, changing the refrigerant from vapor to liquid.
   5. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
   6. SEER (Seasonal Energy Efficiency Ratio): Measure of cooling efficiency for air conditioners and heat pumps. A ratio of total cooling in comparison to electrical energy input in watts per hour. Higher the seer, the more energy efficient the unit. Since 2006, the minimum SEER required by the Department of Energy is 13.00 and 15.00+ SEER is considered high efficiency.
   7. Split System: Combination of an outdoor unit (air conditioner or heat pump) with an indoor unit (furnace or air handler). Split systems must be matched for optimum efficiency.

B. Reference Standards:
   1. American National Standards Institute / Air-Conditioning, Heating, and Refrigeration Institute:
      a. ANSI/AHRI Standard 210/240-2008, 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).
   2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
      a. ANSI/ASHRAE Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
      b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Sustainable Design Submittals:
      a. Product Data for Credit EA: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.

B. Informational Submittals:

1. Tests and Evaluation Reports:
   a. Manufacturer Reports: Equipment check-out sheets.
2. Qualification Statements:
   a. Technician certificate for use in HFC and HCFC refrigerants.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Warranty Documentation:
      1) Final, executed copy of Warranty.
   b. Record Documentation:
      1) Manufacturers Documentation:
         a) Equipment checkout sheet: Complete and sign all items for each unit.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Each unit shall be UL / ULC or ETL labeled.
2. Comply with ANSI/AHRI Standard 210/240.
3. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC·free refrigerants.
4. Energy Efficiency: Equal to or greater than prescribed by ANSI/ASHRAE/IESNA 90.1.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

1.5 WARRANTY

A. Manufacturer's Warranty:
1. Provide Manufacturer's Special LDS Warranty for the following:
   a. Provide ten (10) year limited warranty on compressor and five (5) year limited warranty on parts from date of 'start-up'.
   b. Record 'start-up' date on warranty certificate for each unit.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Manufacturer Contact List:
   a. Air-Rite Manufacturing, Bountiful, UT www.air-ritemfg.com.
      1) Blair Halverson (801) 295-2529.
   b. Carrier Corporation:
      1) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carier.utc.com.
      2) Carrier Utah: Rich Carpenter (Contractors HVAC Supply) (801) 410-6077 rcarpent@mtncom.net.
   c. Lennox Industries:
      1) For pricing and information call Lennox National Account at (800) 367-6285.
      2) Lennox National Contact: Cody Jackson (801) 736-8904 Cody.Jackson@LennoxInd.com.
   d. York International:
      1) Brian Michael (405) 419-6230 brian.k.michael@jci.com.

B. Performance:
1. Capacities: SEER rating as defined by AHRI shall be 13.0 or greater.

C. Manufactured Units:
1. Compressor Units (5 Tons or Less):
a. General:
1) Units shall be operable down to 0 deg F (minus 18 deg C) outdoor temperature.
2) Use R-410a refrigerant.
3) Only one liquid line, one suction line, and one power connection shall be made to each compressor. Provide charging valves.
b. Condenser Coils:
1) Aluminum plate fins mechanically bonded to seamless copper tubes or 'Spine Fin' trade mark system which has aluminum fins epoxy bonded to aluminum tubes or micro-channel.
2) Provide stamped louver coil guard for unit.
c. Fans:
1) Direct driven propeller type.
2) Fan motor shall be single or two speed, thermostatically controlled, permanently lubricated, and designed with permanent protection.
3) Motors shall be resiliently mounted.
4) Each fan shall have a safety guard.
d. Compressor:
1) Each condenser unit shall have only one compressor.
2) Design with following features:
a) Externally mounted brass service valves with charging connections.
b) Crankcase heater.
c) Resilient rubber mounts.
d) Compressor motor-overload protection.
e) Single speed.
e. Controls:
1) Factory wired and located in separate enclosure.
2) Following three paragraphs may not be factory installed and will therefore have to be field installed.
3) Safety devices:
a) High and low pressure cutout.
b) Condenser fan motor-overload devices.
4) Anti-cycle timers to prevent units from starting up again for five minutes after any power interruption.
5) Head pressure type low ambient kit.
f. Casing:
1) Fully weatherproof for outdoor installation. Finish shall be weather resistant.
g. Openings shall be provided for power and refrigerant connections.
h. Panels shall be removable for servicing.
1) West Region:
a) Carrier: 24AAA5.
b) Lennox: 14ACX.
c) York: YCS.

2.2 ACCESSORIES

A. Vibration Isolators:
1. 4 inches (100 mm) square by 3/4 inch (19 mm) thick minimum neoprene type vibration isolation pads anchored solidly to concrete slab.

2.3 ACCESSORIES

A. Vibration Isolators:
1. 4 inches (100 mm) square by 3/4 inch (19 mm) thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify blocking installed under roof decking is in correct location to attach ‘compressor unit curb’.
   2. Notify Architect of unsuitable conditions in writing
   3. Commencement of Work by Installer is considered acceptance of substrate.

3.2 INSTALLATION

A. General:
   1. Set compressor units level on concrete slab on vibration isolation pads located at each corner of unit. This does not apply to compressor units that have composite non-metal bottom.
   2. Do not use capillary tube and piston type refrigerant metering devices.

3.3 FIELD QUALITY CONTROL

A. Manufacturer Services:
   1. Compressor units shall be started up, checked out, and adjusted by compressor unit Installer.
   2. Use equipment checkout sheet provided by Manufacturer:
      a. Complete and sign all items on sheet.

END OF SECTION

SECTION 23 7223

PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install air-to-air energy recovery ventilation units as described in Contract Documents

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 3114: 'Low-Pressure Metal Ducts'.
   3. Section 23 4100: 'Air filters'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 84-2008, 'Method of Testing Air-to-Air Heat/Energy Exchangers'.
   2. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
      b. NFPA 90B: 'Standard for the Installation of Warm Air Heating and Air-Conditioning Systems' 2012 Edition).

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. ASHRAE Compliance:
      a. Capacity ratings for air-to-air energy recovery equipment shall comply with ANSI/ASHRAE 84, 'Method of Testing Air-to-Air Heat Exchangers'.

1.4 WARRANTY

A. Special Warranty:
   1. Warranty energy transfer element for ten years from date of substantial completion of Project.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
   1. Model number(s) as shown on Contract Drawings by RenewAire, Madison, WI www.renewaire.com.

2.2 PERFORMANCE

A. Capacities:
1. Element rated by Manufacturer using method described in ANSI/ASHRAE 84. Exceed 70 percent temperature efficiency.
2. Applicable for range of ventilation up to 800 CFM in each air stream without disposition of dust in elements.

2.3 MANUFACTURED UNITS

A. Energy Recovery Units:
1. Construction:
   a. Fixed plate element.
   b. 20 ga (0.95 mm) galvanized steel case with lapped corners.
   c. Leveling legs.
   d. Access door to blowers, energy transfer elements, and filters.
      1) Gasketed to provide air tight seal.
      2) Insulated with 1/4 inch (6.4 mm) Rubatex.
      3) Attached to unit using stainless steel fasteners.
2. Duct Openings: Four each 1/2 inch (12.7 mm) by 1/2 inch (12.7 mm) square duct collars suitable for connection to duct work.
3. Duct Openings: Four each 12 inch (305 mm) round duct collars suitable for connection to duct work.
4. Blowers:
   a. Forward curved blades directionally driven by open, drip-proof PSC motor rated for continuous duty.
   b. Motor: 2-3/4 horse power, 115 VAC, single phase, 60 hertz.
   c. Baked enamel finish.
5. 24 VAC control voltage.
6. Vibration Isolation: 4 inch (100 mm) by 1/2 inch (12.7 mm) thick minimum neoprene type vibration isolation pads.

2.4 SOURCE QUALITY CONTROL

A. Tests:
1. Provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke development index (SDI) of 50. Meet NFPA 90A and NFPA 90B requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Vibration Isolator Under Each Corner of Energy Recovery Units.

END OF SECTION

SECTION 23 8216

AIR COILS: DX

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:
   1. DX air coils as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 2300: 'Refrigerant Piping'.
   3. Section 23 5417: ‘Gas Fired Furnaces’.

1.2 REFERENCES

A. Definitions:
   1. DX (Direct Expansion): Use of refrigerant directly expanded into evaporation coils in supply air stream of an air conditioning unit.
   2. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.

B. Reference Standards:
   1. American National Standards Institute / Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
      a. ANSI/AHRI Standard 210/240 (2008), 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).
   2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
      a. ANSI/ASHRAE Standard 62.1-2010, 'Ventilation for Acceptable Indoor Air Quality' (ANSI Approved).

1.3 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Reports:
      a. Equipment check-out sheets.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Manufacturers Documentation:
            a) Equipment checkout sheet: Complete and sign all items for each unit.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. DX Coils:
      a. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
         1) AHRI Certified.
      b. American National Standards Institute / Air-Conditioning, Heating, and Refrigeration Institute

1) Comply with requirements of ANSI/AHRI Standard 210/240.

c. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
1) Comply with requirements of ANSI/ASHRAE Standard 62.1, Section 5, 'Systems and Equipment' and Section 7, 'Construction and Startup'.

d. Underwriters Laboratories / Underwriters Laboratories of Canada:
1) Each unit shall be UL / ULC or ETL labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer:
1. Manufacturer Contact List:
a. Carrier Corporation:
1) Carrier National: Douglas Masch (317) 370-2727 doug.mash@carrier.utc.com.
b. Carrier Utah: Rich Carpenter (Contractors HVAC Supply) (801) 410-6077 e-mail rcarpent@mtncom.net.
c. Lennox Industries:
1) For pricing and information call Lennox National Account at 1-800-367-6285.
2) Lennox National Contact : Cory Hickens (951) 332-3658 cory.hicken@LennoxInd.com.
d. York International: David E. Carey 405-419-6536 david.e.carey@jci.com.

2.2 MANUFACTURED UNITS

A. DX Coils:
1. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match air handler.
a. Coil shall have aluminum fins bonded to seamless copper tubing.
b. Comply with ANSI/AHRI Standard 210/240. Provide drain pans with connections at one end.
c. Use thermal expansion valve with brazed joints In place of capillary tube metering device. Compression fittings not acceptable.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a. Horizontal:
1) Carrier: CNPHP.
2) Lennox: CH33.
3) York: MC.
b. Vertical:
1) Carrier: CNPVP.
2) Lennox: CH34.
3) York: FC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install DX Coil to associated air handler per Manufacturer's recommendations.

END OF SECTION

SECTION 23 8333

ELECTRIC RADIANT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install wall heaters as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Division 26: Electrical service and connections.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Units shall be UL listed and comply with NEC.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Berko, Marley Electric Co, Bennettsville. SC www.berkomeh.com.
      b. QMark, Marley Electric Co, Bennettsville, SC www.qmarkmeh.com.
      c. Raywall, Johnson, TN www.raywall.com.

B. Wall Heaters.
   1. Fan type for recess mounting in wall.
   2. 20 ga (0.95 mm) minimum sheet metal casing.
   3. Heating element shall be encased in steel finned casting and protected by thermal switch.
   4. Fan motor shall be heavy duty enclosed and permanently lubricated.
   5. Fan shall be precision balanced and fan-motor assembly mounted to be vibration free.
   6. Units shall be controlled automatically by integral thermostat when heater is in 'ON' position.
   7. Heater shall have built-in fan delay.
   8. Finish: Baked-on enamel.
   9. Design Standard: AWH-4000 by Q-Mark.

PART 3 - EXECUTION: Not Used

END OF SECTION