

**DIVISION 23: HEATING, VENTILATING, AND
AIR-CONDITIONING****23 0000 HEATING, VENTILATING, AND AIR-CONDITIONING**

23 0501 COMMON HVAC REQUIREMENTS
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
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23 1000 FACILITY FUEL SYSTEMS

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23 2000 HVAC PIPING AND PUMPS

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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: Exterior concrete pads and bases for mechanical equipment.
 - 2. Section 05 0523: Quality and requirements for welding.
 - 3. Section 07 8400: Quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 4. Section 07 9213: Quality of sealants used at building exterior.
 - 5. Section 07 9219: Quality of acoustical sealants.
 - 6. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
 - 7. Section 26 2913: 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.

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. Operation And Maintenance Manual Data:
 - a. Modify and add to requirements of Section 01 7000 as follows:
 - 1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
 - 2) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
 - 3) Provide operating instructions to include:
 - a) General description of each HVAC system.
 - b) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
 - c) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
 - 4) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
 - a) 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.
 - b) 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.
 - c) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
 - d) Manual for Honeywell T7350 thermostat published by Honeywell.
 - 5) Include copies of approved shop drawings and copies of warranties required in individual Sections of Division 23.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
- 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.
- B. Identification:
- 1. 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Accept valves on site in shipping containers with labeling in place.
- B. Storage:
- 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.

- C. Handling: Protect bearings during installation. Thoroughly grease steel shafts to prevent corrosion.

1.5 WARRANTY

- A. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
- B. 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.
- C. 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. Valves: Valves of same type shall be of same manufacturer.
- C. Pipe And Pipe Fittings: Use domestic made pipe and pipe fittings on Project. Weld-O-Let and Screw-O-Let fittings are acceptable.
- D. 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.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

- A. B&S Boiler, Inc. – (208) 524-1737
- B. Commercial Metal Works – (208) 357-2347
- C. JM Mechanical – (435) 563-6267
- D. Lewis Corporation – (208) 238-1202
- E. Rexburg Plumbing & Heating – (208) 356-8770
- F. Mountain West Mechanical– (208) 356-0370
- G. Other qualified HVAC Sub-Contractors shall be pre-approved and included in Construction Documents by Addendum.

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.
 2. Replace material or workmanship proven defective with sound material at no additional cost to Owner. 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 alignments, tightenings, and adjustments 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: Four hours.
 - 2) Temperature Control: Two hours.
 - 3) Refrigeration: Two 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: Quality and requirements for welding.
 - 2. Section 07 8400: Quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 3. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
 - 4. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 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.cooperblineline.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.
 - 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 31 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 3111: 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. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A 615-05a, 'Standard Specification for Deformed & Plain Carbon Steel Bars for Concrete Reinforcement.'
 - 2. Sheet Metal & Air Conditioning Contractors National Association / American National Standards Institute:
 - a. SMACNA / ANSI 001-2000, 'Seismic Restraint Manual: Guidelines For Mechanical Systems.'

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 Requirements: System design and installation shall meet seismic requirements as defined in 2000 Edition of International Building Code and applicable state and local codes in accordance with minimum restraint capability of 1.0 g.
- B. Seismic Requirements: Mechanical equipment, piping, and ductwork shall be braced, snubbed, or supported to withstand seismic disturbances and remain operational.
- C. Vibration Isolation Requirements: Isolate equipment from structure by means of resilient vibration and noise isolators.

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 Figures 4.11 to 4.19 in SMACNA Manual.
 - 2) Equipment with Fixed Anchor or Support:
 - a) Restraint designed according to Sections 1621 and 1622 of International Building Code.
 - 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 Figures 4.2 to 4.10 in SMACNA Manual as appropriate.
 - b. Vibration Isolation Requirements:
 - 1) 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 2003 - HVAC Applications, Table 42, Chapter 47.
 - 2) 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.
 - 3) For floor-mounted equipment, use recommendations of Table 42.
 - 4) 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 Table 42, whichever is greater.

- 5) 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 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.
 - 6) 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.
 - 7) Isolate piping and ductwork in mechanical equipment room and piping and ductwork three supports away or 50 feet 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.
 - 8) 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.
 - 9) Incorporate flexible connectors in piping adjacent to reciprocating equipment.
 - 10) Incorporate flexible connections in ductwork adjacent to air-moving units.
 - 11) Elastomeric Isolator: Neoprene or high quality synthetic rubber with anti-ozone and anti-oxidant additives.
 - 12) Nuts, Bolts, And Washers: Electroplated zinc.
 - 13) Isolators Exposed To Weather: Cadmium plated and neoprene coated springs.
- c. 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 63 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 9 000 mm maximum on center spacing.
 - 4) Gas piping shall have additional restraints as scheduled.
4. Ductwork:

- a. Protect isolated and non-isolated rectangular ductwork 4 sq ft 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 9 000 mm 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. Includes But Not Limited To:
1. Furnish and install identification of HVAC equipment and piping as described in Contract Documents.

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. Paint:
 - a. Paints specified are from Pittsburgh Paint & Glass (PPG), Pittsburgh, PA www.ppgaf.com.
 - b. One Coat Primer:
 - 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
 - 2) 6-205 Metal Primer under dark color paint.
 - 3) 6-6 Metal Primer under light color paint.
 - c. Finish Coats: Two coats 53 Line Acrylic Enamel.
 - d. Class Two Quality Standard. See Section 01 6200.
 - 1) Paint of equal quality from other Manufacturers may be used. Maintain specified colors, shades, and contrasts.
 2. Labels:
 - a. Equipment Identification: Black formica, with white reveal when engraved. 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:
 - a. Thermostats and control panels in mechanical spaces.
 - b. Furnaces.
 - c. Condensing units.
 - d. Electric duct heaters.
 - e. 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. Leave equipment in like-new appearance.
 2. Only painted legends, directional arrows, and color bands are acceptable.
 3. 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 7500 mm** on long continuous lines.
 - e. Stenciled symbols shall be one inch high and black.

END OF SECTION

SECTION 23 0593**DUCT TESTING, ADJUSTING, AND BALANCING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Test, balance, and adjust air duct systems as described in Contract Documents.
- B. Related Sections:
 - 1. Other Sections of Division 23:
 - a. Completing installation and start-up of mechanical systems, and changing sheaves, belts, and dampers as required for correct balance.
 - b. Assisting Balancing Agency in testing and balancing of mechanical system.

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Perform testing and balancing in complete accordance with Associated Air Balance Council Standards for Field Measurement & Instructions, Form P1266, Volume I. Record test data on AABC standard forms or facsimile.
 - 2. Noise level shall not exceed PNC 35 in Chapel or Cultural Center when all mechanical equipment is operating.

1.3 SUBMITTALS

- A. Quality Assurance / Control:
 - 1. Four copies of complete test data for evaluation and approval.
 - 2. Test And Balance Report:
 - a. Complete with logs, data, and records as required herein. Print logs, data, and records on white bond paper bound together in report form.
 - b. Certified accurate and complete by Balancing Agency's certified test and balance engineer.
 - c. Contain following general data in format selected by Balancing Agency.
 - 1) Project Number.
 - 2) Project Title.
 - 3) Project Location.
 - 4) Project Architect and Mechanical Engineer.
 - 5) Test and Balance Agency and Certified Engineer.
 - 6) Contractor and mechanical sub-contractor.
 - 7) Dates tests were performed.
 - 8) Certification Document.
 - 9) Report Forms similar to AABC Standard format.
 - d. Report shall include following:
 - 1) Preface suggesting abnormalities and problems encountered.
 - 2) Instrumentation List including type, model, manufacturer, serial number, and calibration dates.
 - 3) System Identification reporting location of zones, supply, return, and exhaust openings.
 - 4) Record following for each piece of air handling equipment:
 - a) Manufacturer, model number, and serial number.
 - b) Design and manufacturer rated data.
 - c) Actual CFM.
 - d) Suction and discharge static pressure of each fan.

- e) Outside-air and return-air total CFM.
 - f) Actual operating current, voltage, and brake horsepower of each fan motor.
 - g) Final RPM of each motor.
 - h) Fan and motor sheave manufacturer, model, size, number of grooves and center distance.
 - i) Belt size and quantity.
 - j) Static-pressure controls final operating set points.
3. Bind approved copy of report in Operations And Maintenance Manual for Division 23.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Work of this Section shall be performed by independent Air Testing And Balance Agency specializing in testing and balancing of heating, ventilating, and cooling systems to balance, adjust, and test air moving equipment, air distribution, and exhaust systems.
 2. Agency shall provide proof of having successfully completed at least five years of specialized experience in air and hydronic system balancing. Work by this Agency shall be done under direct supervision of qualified heating and ventilating engineer employed by Agency.
 3. Agency shall be approved in writing by Architect.
 4. Neither Architect's engineering consultant or anyone performing work on this Project under other Sections of Division 23 shall be permitted to do this work.

1.5 SCHEDULING

- A. Award test and balance subcontract to Agency upon receipt of Notice To Proceed to allow Agency to schedule this work in cooperation with other Sections involved and to comply with completion date.
- B. During construction, Agency shall inspect installation of pipe systems, sheet metal work, temperature controls, and other component parts of mechanical systems. Perform inspections as follows.
 1. One inspection when 60 percent of ductwork is installed.
 2. One inspection when 90 percent of equipment is installed.
- C. Do not begin air testing and balancing until:
 1. After completion of air cooling, heating, and exhaust systems including installation of specialties, devices, and new filters.
 2. Proper function of control system components including electrical interlocks, damper sequences, air and water reset, and fire and freeze stats has been verified.
 3. Automatic temperature controls have been calibrated and set for design operating conditions.
 4. Verification of proper thermostat calibration and setting of control components such as static pressure controllers and other devices that may need set points changed during process of balancing system.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 ACCEPTABLE TEST AND BALANCE COMPANIES

- A. Flo-Rite – (208) 238-8330
- B. Environmental Engineers – (208) 238-5817
- C. Building Systems Technologies – (208) 362-5245

- D. Other qualified HVAC Sub-Contractors shall be pre-approved and included in Construction Documents by Addendum.

3.2 PREPARATION

- A. Heating, ventilating, and cooling systems and equipment shall be in full operation and continue in operation during each working day of testing and balancing.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
1. If requested, conduct tests in presence of Architect.
 2. Instruments used by Agency shall be accurately calibrated and maintained in good working order.
 3. Air Testing And Balancing Procedure:
 - a. Perform tests at high and low speeds of multi-speed systems and single speed systems. Perform following testing and balancing functions in accordance with Associated Air Balance Council National Standards:
 - 1) Fan Speeds: Furnaces And Fan Coil Units (with direct drive motors): Set fan speed to lowest possible setting that will achieve design CFM requirements. Adjust down from Contractor setting, if necessary.
 - 2) Current And Voltage: Measure and record motor current and voltage.
 - 3) Pitot-Tube Traverse: Perform pitot-tube traverse of main supply and return ducts to obtain total CFM.
 - 4) Outside Air: Test and adjust system minimum outside air by pitot-tube traverse.
 - 5) Static Pressure: Test and record system static pressures, including suction and discharge static pressure of each fan.
 - 6) Air Temperature: Take wet and dry bulb air temperatures on entering and leaving side of each cooling coil. Dry bulb temperatures shall be taken on entering and leaving side of each heating unit.
 - 7) Main Ducts: Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
 - 8) Branch Ducts: Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
 - 9) Tolerances: Test and balance each diffuser, grille, and register to within 10 percent of design requirements.
 - 10) Identification: Identify the location and area of each grille, diffuser, and register. Record on air outlet data sheets.
 - 11) Description: Record size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
 - 12) Drafts: Adjust diffusers, grilles, and registers to minimize drafts.
 - b. Permanently mark all outside air, supply air, and return air damper positions after balancing has been completed.
 4. Smoke testing, or some other approved means, may be required to determine leak locations if air balance report indicates that any system's CFM total is less than 10 percent of design CFM. Prior to test, verify that system's duct joints have been sealed as specified and that air moving device in question is supplying required design system air flow. Architect will approve test method required. If smoke test is selected, use following procedure. Provide necessary precautions to protect those performing or observing test from being exposed to smoke.
 - a. Use zinc chloride smoke candles, titanium tetrachloride ampules or sticks, or other devices acceptable to Architect to generate smoke.
 - b. Close openings in duct except for one opening at farthest end of duct run.
 - c. Circulate smoke at pressurized condition of $1/2$ inch 13 mm minimum water gauge static pressure.
 - d. Report findings to Architect in writing.
- B. Final Inspection And Adjustments:
1. System shall be balanced and reports submitted to Architect before final inspection.

2. Balancing Agency shall be represented at final inspection meeting by qualified testing personnel with balancing equipment and two copies of air balancing test report.
 - a. Architect will choose and direct spot balancing of one zone. Differences between the spot balance and test report will be justification for requiring repeat of testing and balancing for entire building. If recheck testing demonstrates measured flow deviation of 10 percent or more from recorded information on report, report will be rejected and new inspection and report will be made and resubmitted.
 - b. Perform re-balancing in presence of Architect and subject to its approval.
 - c. If re-balancing is required, submit revised air test and balance reports to Architect before Substantial Completion.
 - d. Spot balance and rebalance shall be performed at no additional cost to Owner.
3. Where furnace supplied to job site provides over 5 percent more air than schedule requirements, rooms supplied by that furnace shall have their supply air quantities increased by ratio of actual total air quantity supplied to minimum air quantity required by furnace schedule.

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 3113: Low-Pressure Metal Ducts.
 - 2. Section 23 3300: Acoustic 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.
 - 4. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
 - 5. Owens-Corning, Toledo, OH www.owenscorning.com.

2.2 MATERIALS

- A. Thermal Wrap Duct Insulation:
 - 1. 1-1/2 inch 38 mm thick fiberglass with factory-laminated, reinforced aluminum foil scrim kraft facing and density of one lb/ per cu ft.
 - 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 100 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. On outside air ducts and combustion air ducts within building insulation envelope.
 - b. On other air ducts where indicated on Drawings.
 - 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.
 - 2. Furnish and install insulation for hot water heating and return piping system as described in Contract Documents.
 - 3. Furnish and install insulation for steam and condensate piping system as described in Contract Documents.

- B. Related Requirements:
 - 1. Section 23 0501: General Mechanical Requirements.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials and work dry and free from damage.
- B. 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.armacell.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.
 - 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
2-1/8 inches and larger	One inch or two layers of 1/2 inch

Pipe Size, Outside Diameter	Insulation Thickness
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25 mm and smaller	13 mm
29 to 50 mm	19 mm
54 mm and larger	25 mm or two layers of 13 mm

- 1) One inch 25 mm 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.

3.3 FIELD QUALITY CONTROL

- A. 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 0800
DEMOLITION AND REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- 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.

1.2 SUMMARY

- A. Under this section remove obsolete piping and mechanical equipment and relocate, reconnect or replace existing piping affected by demolition or new construction. Remove concealed piping abandoned due to demolition or new construction, or cap piping flush with existing surfaces.

1.3 DRAWINGS AND EXISTING CONDITIONS

- A. All relocations, reconnections and removals are not necessarily indicated on the drawings. As such, the Contractor shall make adequate allowance in his proposal for this work as no extra charges will be allowed for these items.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 TEMPORARY CONNECTIONS

- A. Where existing piping must remain in service to supply occupied areas during construction, provide temporary piping, connections, and equipment to maintain service to such areas. All shall be performed in a neat and safe manner to prevent injury to the building or its occupants.

3.2 DRILLING, CUTTING, PATCHING

- A. All Required drilling, cutting, block-outs and demolition work required for the removal and/or installation of the mechanical system is the responsibility of this Contractor.
- B. No joists, beams, girders, trusses or columns shall be cut by any Contractor without written permission from the Architect.
- C. The patching, repair, and finishing to existing or new surfaces is the responsibility of this Contractor, unless specifically called for under sections of specifications covering these materials.
- D. Disconnect all equipment that is to be removed or relocated. Relocate any existing equipment that obstructs new construction.

3.3 EXISTING PIPING TO REMAIN IN USE

- A. Where affected by demolition or new construction, relocate, replace, extend, or repair piping and equipment to allow continued use of same. Use methods and materials as specified for new construction.

3.4 MATERIALS AND EQUIPMENT REMOVED

- A. All obsolete materials, piping, and equipment shall become the property of the Contractor and be removed from the site promptly.

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 23 0501: Common HVAC Requirements.
 - 2. Section 23 0593: Air test and balance.
 - 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. Informational Submittals:
 - 1. Qualification Statements: Submit document from Approved Distributor confirming contractor sponsorship.

- B. Closeout Submittals:
 - 1. Record Documentation:
 - a. Provide two CD copies with fully commissioned LonSpec database.
 - b. Leave with O&M Manual specified in Section 23 0501.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer:
 - a. Before bidding, obtain sponsorship from a local, Approved Distributor specified under PART 2 PRODUCTS. Initial requirements for sponsorship are:
 - 1) Be one of following Honeywell supported partners:
 - a) Honeywell-Automation Control Specialist (ACS).
 - b) Honeywell-Commercial Comfort & Energy Specialist (CCES).
 - c) Honeywell Authorized Control Integrator (ACI).
 - 2) Receive product training from and exhibit LCBS system skills to sponsoring Approved Distributor.

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.
 - d. ICCA Firex, Carol Stream, IL www.icca.invensys.com.
 - e. System Sensor, St Charles, IL www.systemsensor.com.
 - f. Zimmerman Technologies, Renton, WA (425) 255-1906.

B. Distributors:

Obtain LonSpec database, Command Display Interface, RP panels, thermostats, and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301.

1. Obtain WebStat Building Manager, RP panels, thermostats, and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301:
2. Idaho:
 - a. Wilson-Mohr, Inc: (801) 486-8791. kmurphy@wilsonmohr.com Kathy Murphy
 - b. Control Equipment Co: (800) 452-1457. rhowe@controlequiputah.com Ray Howe
 - c. Control Solutions & Design: (208) 375-4422. pdl@csdidaho.com Paul Lachowsky
 - d. RSD Total Control: (800) 245-8007, ext 255. jransford@rsd.net Joe Ransford
3. Utah:
 - a. Wilson-Mohr, Inc: (801) 486-8791. kmurphy@wilsonmohr.com Kathy Murphy
 - b. Control Equipment Co: (800) 452-1457. rhowe@controlequiputah.com Ray Howe
 - c. RSD Total Control: (801) 224-0797. dcraner@rsd-tc.com Dan Craner

C. Performance:

1. Design Criteria:
 - a. Automatic Temperature Control System design concept utilizes communicating thermostats located near furnace, with electronic sensors and electric / electronic actuation of dampers and with thermostats connected with Echelon approved communication cable. Display module will also reside on Echelon network and provide single point of system access.
 - b. Network communications and control devices will be LonWorks compliant. System shall include HVAC control, command display user interface, and maintenance management functions related to normal building operations.
2. Design Criteria:
 - a. Automatic Temperature Control System design concept utilizes communicating thermostats located near furnace, with electronic sensors and electric / electronic actuation of dampers and with thermostats connected with Echelon approved communication cable. A WebStat Building Manager will interface with the thermostats to provide access via internet browser.
 - b. Network communications and control devices will be LonWorks compliant. System shall include HVAC control, WebStat Building Manager to provide maintenance management functions related to normal building operations.

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 Y7335H1009 consisting of following:
 - (1) Communicating Thermostat: Low voltage type provided with automatic change-over feature for both heating and cooling stages, seven-day / 365 day program with two starts and stops per day, and provisions for damper operators. Honeywell T7350H1009.
 - (2) Push-Button Remote Room Sensor: Honeywell T7771A1005 with three push buttons, OVERRIDE, WARMER, COOLER, and with selectable ohm resistance, 10k or 20k.

- (3) Discharge Air Sensor: Honeywell C7041B2005, 6 inch
- b. Plain Face Remote Room Sensor:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a) Honeywell TR21-A, plain face, 10k ohms.
 - b) Honeywell TR21, plain face, 20k ohms.
- c. Non-Programmable Thermostat:
 - 1) Low voltage type.
 - 2) Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - a) Honeywell T87K1007 with 50010944-001 range stop.
- 2. 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 Sensor Guard with integral wood base by Zimmerman Technologies.
- 3. Duct Smoke Detectors:
 - a. Duct mounted smoke detector in systems with airflow greater than 2000 CFM.
 - b. Intelligent lowflow photoelectric duct smoke detector with flash scan.
 - c. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - 1) Notifier Model FSD-751RPLA by Honeywell, Minneapolis, MN.
- 4. Transformer:
 - a. 120 / 24 V, 50VA Honeywell AT150F.
 - b. 120 / 24 V, 75VA Honeywell AT175F.
- 5. 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 S0524-2POS-SW2 w/ Auxiliary switches.
- 6. 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) Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - a) Honeywell AK3798.
- 7. 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. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Standard: LDS Models RP-1 or RP-5.
 - 2) Dehumidification: LDS Model RP-5DH.
- 8. Outdoor Air Temperature Sensor:
 - a. Minus 30 to plus 90 deg F minus 1 to plus 32 deg C operating range.
 - b. 5 foot capillary length.
 - c. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - 1) Honeywell: T6031A1052.
- 9. CO₂ Return Air Sensor:
 - a. Duct mount with display.
 - b. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - 1) Honeywell: C7232B1006.
- 10. Web based building manager:
 - a. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - 1) Honeywell Webstat: Model W7350A1000.

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, Bishop Zone:
 - a. Sensors shall control zone HVAC equipment by averaging temperature in spaces containing sensors.
 - b. Third dummy sensor, typically located in unlocked common space, is place-holder for OVERRIDE, WARMER, and COOLER buttons and does not sense temperature.
6. Two Sensor Averaging, Stake Suite: One sensor has OVERRIDE, WARMER, COOLER buttons. Set jumper to appropriate setting necessary to average with another sensor.
7. Three Sensor Averaging:
 - a. Sensors shall control zone HVAC equipment by averaging temperature in spaces containing sensors.
 - b. Fourth dummy sensor, typically located in unlocked common space, is place-holder for OVERRIDE, WARMER, and COOLER buttons and does not sense temperature.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

- A. Curtis Electric – (208) 745-7833
- B. Mecham Electric – (208) 681-9130
- C. Weeks Electric – (208) 356-6547
- D. Other qualified HVAC Sub-Contractors shall be pre-approved and included in Construction Documents by Addendum.

3.2 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 Cable:
 1. Network communicating thermostats and Command Display Interface together with specified communicating cable.
 2. Network communicating thermostats and WebStat Building Manager together with specified communicating cable.
 3. Do not bundle communication cables with cables of other systems. Maintain 12 inches minimum distance from wires of other systems, except communication cable may cross other low-voltage wiring if done perpendicularly.

- C. Safety Controls: Interlock duct smoke detectors to keep heating, cooling, and system fan from operating when detector is energized.
- D. Mount damper actuators and actuator linkages external of airflow. Make certain dampers operate freely without binding or with actuator housing moving.
- E. Paste copy of record control wiring diagram on back of relay panel door cover for each multiple furnace system.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service:
 - 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.

3.4 SYSTEM STARTUP

- A. Using database provided by distributor, modify zone names to match local designations and input local schedules. Information shall be provided by Architect from local Facilities Manager.
 - 1. After installation, exercise system by commanding actuators to stroke dampers for smooth operation and tight close-off. Test controller outputs to prove proper fan, damper, cooling, and heating operation. Exercise and verify setpoint changes. Exercise and monitor specified relationships between area demands and equipment control for proper operation. Exercise remote wall sensor over-rides to make certain system can be placed into and out of over-ride from wall sensor.
 - 2. Download local time into designated time master thermostat.

3.5 SYSTEM STARTUP

- A. For systems with WebStat Building Manager.
 - 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 Static, IP address, Network Mask, Default Gateway, Primary DNS Server, Local Host Name, Local Domain Name.
 - 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. Use WebStat as network time master from "System" tab in WebStat.
 - 3. Set remote sensor to T7771.
 - 4. Set remote humidity to none unless using remote humidity sensor on DH systems.
 - 5. Set Occupancy sensor to None.
 - 6. Set Discharge Air Temp sensor to Remote.
 - 7. Set Heating / Cooling to proper stages
 - 8. Set heat cycle rates to 9 cph and cooling to 4 cph. Set discharge high limit to 110 degrees but do not activate (check) the high limit option. This is only to be used later by owner if equipment experiences issues with system overshoot.
 - 9. Set Aux relay to "Time of Day".
 - 10. Set fan switch operation to "ON".
 - 11. Set minimum UnOcc start time for all days. No days shall be scheduled Unconfigured.
 - 12. Set occupied start times to match meeting start times; provided by local FM manager.
 - 13. Place all zone over-ride durations to 1 hour except for Bishop and Stake area which shall be set to 2 hours.
 - 14. Set Occupied default heating setpoints to 70 degrees, cooling setpoints to 74 degrees.

15. Set UnOccupied default heating setpoint to 60 degrees, cooling setpoints to 90 degrees.
16. Set each zone to applicable Holiday scheduling for General & Stake Conferences.

B. WebStat settings

1. Obtain from IT a LAN / WAN SMTP email server name for system alarming; where applicable.
2. Create alarm setpoint of 55 degrees low limit / 92 degrees high limit for all zones.
3. Create separate Administrative User level for Local FM Manager.

3.6 ADJUSTING

- A. Program minimum of one day's operation into thermostat memory function.

3.7 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 two sessions for up to six hours total. First session will occur between system completion and Substantial Completion. Second session will occur within 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, use of specified command display interface functions, troubleshooting of sensors, etc, as follows:
 - 1) Control System Overview:
 - a) Show access to system through both individual thermostats and Command Display and how network works. Demonstrate scheduling for Stake and General Conferences.
 - b) Identify LonSpec database backup CD.
 - 2) Thermostat Programming From Keypad And Command Display Module: Instructions on developing setpoints and schedules, including Stake and General Conference days, and adjusting program modify descriptive zone names, local zone schedules, and local zone temperatures..
 - 3) Thermostat Operation:
 - a) Identify and explain use of buttons on thermostat face, I.E. 'i' or information button, warmer button, and cooler button.
 - b) Identify and explain buttons under thermostat cover.
 - c) Provide training for Thermostat Palm Program.
 - d) Identify thermostat used as 'Time Master' and provide training on its function.

END OF SECTION

SECTION 23 1123**FACILITY NATURAL-PROPANE 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 propane 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: Procedure and quality of excavation.
 - 4. Section 31 2323: Procedure and quality of backfill and compaction.
 - 5. Section 33 5100: Gas line from meter to main.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A 53-05, 'Standard Specification for Pipe, Steel and Hot-Dipped, Zinc-Coated, Welded and Seamless.'
 - b. ASTM A 234-05a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.'
 - c. ASTM D 2513-05, 'Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.'

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Welders shall be certified and bear evidence of certification 30 days before commencing work on project. 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. Polyethylene pipe installers shall be properly trained and certified in procedure for joining polyethylene pipe.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. 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.
 - 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. KOSO by Pacific Seismic Products Inc, Lancaster, CA www.psp4gasoff.com.
 - h. Watts Regulator Co, North Andover, MA www.wattsreg.com.

- B. Materials:
 1. Above-Ground Pipe And Fittings:
 - a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of ASTM A 53.
 - b. Welded forged steel fittings meeting requirements of ASTM A 234 or standard weight malleable iron screwed.
 2. Below-Ground Pipe And Fittings: Polyethylene pipe and fittings meeting requirements of ASTM D 2513 with No. 14 coated copper trace wire.
 3. Valves:
 - a. 125 psi 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 41-560 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel pipe installed through air plenums, in walls, and pipes 2-1/2 inches 63 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 600 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.

3.2 FIELD QUALITY CONTROL

- A. Field tests: Subject all portions of gas piping system, in sections or in entirety, to air pressure of 75 psig and prove airtight for 4 hours. Disconnect equipment not suitable for 75 psig 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. Related Requirements:
 - 1. Section 23 0501: Common HVAC Requirements.
 - 2. Section 23 0719: Refrigerant Piping Insulation.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A 36-05, 'Standard Specification for Carbon Structural Steel.'
 - b. ASTM B 280-05, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.'
 - 2. American Welding Society / American National Standards Institute:
 - a. AWS / ANSI A5.8-2004, 'Specification for Brazing Filler Metal.'

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 CFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer: Refrigerant piping shall be installed by a refrigeration subcontractor licensed by State and by technicians certified in use of CFC and HCFC refrigerants.

PART 2 - PRODUCTS**2.1 COMPONENTS**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Emerson Climate Technologies, St Louis, MO www.emersonflowcontrols.com.
 - b. Cush-A-Clamp by ZSI Manufacturing, Canton, MI www.cushaclamp.com.
 - c. Elkhart Products Corp, Elkhart, IN www.elkhartproducts.com.
 - d. Handy & Harman Products Division, Fairfield, CT www.handy-1.com.
 - e. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
 - f. Henry Valve Co, Melrose Park, IL www.henrytech.com.
 - g. Hilti Inc, Tulsa, OK www.hilti.com.
 - h. Hydra-Zorb Co, Auburn Hills, MI www.hydra-zorb.com.
 - i. Mueller Steam Specialty, St Pauls, NC www.muellersteam.com.

- j. Nibco Inc, Elkhart, IN www.nibco.com.
- k. Packless Industries, Waco, TX www.packless.com.
- l. Parker Corp, Cleveland, OH www.parker.com.
- m. Sporlan Valve Co, Washington, MO www.sporlan.com.
- n. Sherwood Valves, Washington, PA www.sherwoodvalve.com.
- o. Thomas & Betts, Memphis, TN www.superstrut.com.
- p. Unistrut Corp, Wayne, MI www.unistrut.com.
- q. Universal Metal Hose, Chicago, IL www.universalmetalhose.com.
- r. Vibration Mountings & Controls, Bloomingdale, NJ www.vmc-kdc.com.
- s. Virginia KMP Corp, Dallas, TX www.virginiakmp.com.

B. Materials:

- 1. Refrigerant Piping:
 - a. Meet requirements of ASTM B 280, 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. Connection Material:
 - a. Brazing Rods in accordance with ANSI / AWS 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.
- 4. 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.
- 5. Filter-Drier:
 - a. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type using flared copper fittings.
 - 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.
- 6. 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.
- 7. Refrigerant Piping Supports:
 - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A 36.
 - 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.
 - d. Protective Cover: 18 ga steel, hot-dipped galvanized.

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. Locate traps at vertical rises against flow in suction lines.
- 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.
4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:

1. Support Spacing:
 - a. Piping 1-1/4 inch And Larger: 8 feet on center maximum.
 - b. Piping 1-1/8 inch And Smaller: 6 feet 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 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.
2. 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 rivet 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 Fluoropon 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. Furnish and install condensate drain piping as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: Common HVAC Requirements.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM B 88-03, 'Standard Specification for Seamless Copper Water Tube.'

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, and auxiliary drain pans.
- B. Manufactured Units
 - 1. Condensate Pump
 - a. Rated at 225 gph at 15 feet total head. Complete with one gallon polystyrene tank with pump and automatic float control. 1/5 hp, 120 V, one phase, 60 Hertz.
 - b. Condensate piping shall be Type M copper or Schedule 40 PVC.
 - c. Approved Manufacturers -
 - 1) No. CU551UL by Beckett Pumps, (888) 232-5388
 - 2) No. VCL45S by Little Giant Pump Co, Oklahoma City, OK (405) 947-2511

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.
 - 3. Do not combine auxiliary drain pan piping with furnace / Cooling Coil Condensate drain piping.

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 4316: Duct testing, adjusting, and balancing of ductwork.
 - 2. Section 07 9219: Quality of acoustic sealant.
 - 3. Section 23 0501: Common HVAC Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

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

1.3 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: 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.

- 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 close to each transverse joint and elsewhere 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. 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 4316: Duct, Testing, Adjusting, and Balancing.
 - 2. Section 23 0713: Thermal Insulation for ducts, plenum chambers, and casings.
 - 3. Section 23 3001: Common Duct Requirements.
 - 4. Section 23 0933: Temperature control damper actuators and actuator linkages.
 - 5. Section 23 0933: Furnishing of duct smoke detectors.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A 653-02a, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.'

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 of ASTM A 653, 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 Butter Tak by Cain Manufacturing Co Inc, Pelham, AL www.cainmfg.com.
 - 2) DP 1010 by Design Polymerics, Fountain Valley, CA www.designpoly.com.
 - 3) SAS by Duro Dyne, Bay Shore, NY www.durodyne.com.
 - 4) Iron Grip 601 by Hardcast Inc, Wylie, TX www.hardcast.com.
 - 5) 15-325 by Miracle / Kingco, Div ITW TACC, Rockland, MA www.taccint.com.
 - 6) 44-39 by Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
 - 7) Airseal #11 by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.
 - 8) Water Base Duct Sealer by Airseal LLC, Columbus, OH www.mcgillairseal.com.
 - 3. Duct Sealer For Exterior Ducts:
 - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.

- 1) Hardcast DT Tape and RTA-50 liquid adhesive by Hardcast Inc, Wylie, TX
www.hardcast.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. Round Duct:
 - 1) Spiral Seam: 28 ga 0.4 mm minimum for ducts up to and including 14 inches 350 mm in diameter.
 - 2) Longitudinal Seam:
 - a) 28 ga 0.4 mm minimum for ducts up to and including 8 inches 200 mm in diameter.
 - b) 26 ga 0.48 mm minimum for ducts over 8 inches 200 mm and up to 14 inches 350 mm in diameter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work: Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures specified in Section 23 0593, at no additional cost to Owner.
- B. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.
- C. 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.
- D. Ducts shall not bear on top of structural members.
- E. Paint ductwork visible through registers, grilles, and diffusers flat black.
- F. Properly flash where ducts protrude above roof.
- G. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

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: 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 A 653-02a, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.'
 - b. ASTM C 1071-00, 'Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Acoustical Material).'
 - c. ASTM C 1338-00, 'Standard Test Method for Determining the Fungi Resistance of insulation Materials and Facings.'

PART 2 - PRODUCTS**2.1 ACCESSORY PRODUCTS**

- 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 Polymeric, 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. Honeywell Inc, Minneapolis, MN www.honeywell.com.
- v. Industrial Acoustics Co, Bronx, NY www.industrialacoustics.com.
- w. Johns-Manville, Denver, CO www.jm.com.
- x. Kees Inc, Elkhart Lake, WI www.kees.com.
- y. Knauf Fiber Glass, Shelbyville, IN www.knauffiberglass.com.
- z. Manson Insulation Inc, Brossard, QB www.isolationmanson.com.
- aa. Metco Inc, Salt Lake City, UT (801) 467-1572.
- bb. Miracle / Kingco, Rockland, MA www.taccint.com.
- cc. Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
- dd. Nailor Industries Inc, Houston, TX www.nailor.com.
- ee. Owens Corning, Toledo, OH www.owenscorning.com.
- ff. Polymer Adhesive Sealant Systems Inc, Irving, TX www.polymeradhesives.com.
- gg. Pottorff Company, Fort Worth, TX www.pottorff.com.
- hh. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
- ii. Sheet Metal Connectors Inc, Minneapolis, MN www.smconnectors.com.
- jj. Techno Adhesive, Cincinnati, OH www.technoadhesives.com.
- kk. Titus, Richardson, TX (972) 699-1030. www.titus-hvac.com
- ll. McGill AirFlow, Groveport, OH www.mcgillairflow.com.
- mm. McGill AirSeal, Columbus, OH www.mcgillairseal.com.
- nn. Utemp Inc, Salt Lake City, UT (801) 978-9265.
- oo. Ventfabrics Inc, Chicago, IL www.ventfabrics.com.
- pp. 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 2.2 kg per cu meter density fiberglass conforming to requirements of ASTM C 1071. Liner will not support microbial growth when tested in accordance with ASTM C 1338.
- 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) Permacote Linacoustic HP 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) Hardcast: Coil-Tack.
 - e) Miracle / Kingco: PF-101.
 - f) Mon-Eco: 22-67 or 22-76.
 - g) Polymer Adhesive: Glasstack #35.
 - h) Techno Adhesive: 133.
 - i) 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 Inc: 'DynaPoint' Series RP-9 pin.
 - b) Cain.
 - c) Duro Dyne.
 - d) Gripnails 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 250 deg F 121 deg C.
 - c. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Cain: N-100.
 - 2) Duro Dyne: MFN.
 - 3) Elgen: ZLN.
 - 4) Ventfabrics: Ventglas.
 - 5) 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) Flexmaster: Spin Door.
 - e) Kees Inc: ADH-D.
 - f) Nailor: 085H-01.
 - g) Pottorff: 60-HAD.
 - h) Ruskin: ADH-24.
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-38.
 - b) Dyn Air: QPS-385
 - c) Ventfabrics: Ventline 555.
 - d) 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) Metco Inc.
 - d) Ventfabrics: 666 Ventlok.
 - e) Young: 301.
 - c. Volume Dampers:
 - 1) Rectangular Duct:

- a) Factory-manufactured 16 ga 1.59 mm galvanized steel, single blade and opposed blade type with 3/8 inch 10 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) Pottorff: CD-42.
 - (9) Ruskin: MD-35.
 - (10) Utemp: CD-OB.
- 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) Honeywell: D-643.
 - (7) Pottorff: CD-52.
 - (8) Ruskin: CD-60.
- 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) Cesco: FBD 101.
 - e) Daniel: FBD-H/V.
 - f) Pottorff: 50FBD.
 - g) Ruskin: NMS2.
 - h) UTEMP: BFEA.
5. Air Turns:
- a. Single thickness vanes. Double thickness vanes not acceptable.
 - b. 4-1/2 inch 113 mm wide vane rail. Junior vane rail not acceptable.

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 ducts:
 - 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.
- 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 3316**FIRE AND SMOKE DAMPERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install fire and smoke dampers described in Contract Documents.
- B. Related Sections:
 - 1. Section 15 3001: Common Duct Requirements.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Dampers shall conform to NFPA and SMACNA requirements and bear UL label.
 - 2. Dampers shall be approved by fire authorities having jurisdiction where so required.
 - 3. Wall and floor fire dampers shall conform to UL 555 'Fire Damper Test Standard.'
 - 4. Ceiling fire dampers shall conform to UL 555C 'Ceiling Damper Test Standard.'
 - 5. Smoke Dampers shall conform to UL 555S 'Leakage Rated Damper Test Standard.'
 - 6. Combination fire / smoke dampers shall conform to UL 555 'Fire Damper Test Standard' and to UL 555S 'Leakage Rated Damper Test Standard.'

1.3 MAINTENANCE

- A. Extra Materials: Leave six fusible links of each rating type used on Project with Owner.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Fire Dampers:
 - 1. Walls And Floors (Type 1):
 - a. Type 'B.'
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Air Balance: Model 119B.
 - 2) Cesco: Model 15SB.
 - 3) Greenheck: Model FD150XB.
 - 4) Pottorff: Model VFD-10.
 - 5) Ruskin: Model DIBD20.
 - 6) Safe-Air: Model 150B Sleeved.
 - 2. Ceilings (Type 2):
 - a. Radiation type ceiling fire damper.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - 1) Air Balance: Model 289.
 - 2) Cesco: Model RCI.
 - 3) Greenheck: Model CRD-60B.
 - 4) Pottorff: Model CFD-20.
 - 5) Ruskin: Model CFD-LDS Series.

6) Safe-Air: Model 410A.

- B. Smoke Dampers (Type 3):
1. Rated Class II **350 deg F 177 deg C** minimum.
 2. Power open-fail close non-stall type motorized damper operating at 115 V and drawing 0.2 AMP maximum.
 3. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Air Balance: Model S2.
 - b. Cesco: Model S2.
 - c. Greenheck: Model SMD202.
 - d. Pottorff: SD-142.
 - e. Ruskin: Model SD36.
 - f. Equal by Prefco as approved by Architect before bidding. See Section 01600.
- C. Standard Combination Fire / Smoke Dampers (Type 4):
1. 1-1/2 hour rated and Class II **250 deg F 121 deg C** leakage rated minimum.
 2. Power-open, fail-close non-stall type motorized damper operating at 115 V and drawing 0.2 AMP maximum.
 3. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Air Balance: Model FS2.
 - b. CESCO: Model CG2.
 - c. Greenheck: Model FSD212.
 - d. Pottorff: Model FSD-142.
 - e. Ruskin: Model FSD36.
 - f. Safe-Air: Model 772.
 - g. Equal by Prefco as approved by Architect before bidding. See Section 01600.
- D. Corridor Combination Fire / Smoke Dampers (Type 5):
1. One hour rated and Class II **250 deg F 121 deg C** leakage rated minimum for protection of tunnel type corridor ceilings with horizontal walls.
 2. Power-open, fail-close non-stall type motorized damper operating at 115 V and drawing 0.2 AMP maximum.
 3. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Air Balance: Model FS2C.
 - b. CESCO: Model TG2C.
 - c. Greenheck: Model CFSD212.
 - d. Ruskin: Model FSD36C.
 - e. Pottorff: FSD-172.
 - f. Prefco: 5050TC.

2.2 ACCESSORIES

- A. Damper Actuators:
1. For Type 3, 4, and 5 dampers.
 2. Category Four Approved Product. See Section 01 6200 for definitions of Categories.
 - a. Honeywell ML 4115.

2.3 MANUFACTURERS

- A. Contact Information:
1. Air Balance Inc, Holland, OH www.air-balance.com.
 2. Cesco Products, Minneapolis, MN www.cescoproducts.com.
 3. Greenheck Corp, Schofield, WI www.greenheck.com or Greenheck Corp/ E H Price Ltd, Winnipeg, MB (204) 669-4220.
 4. Pottorff, Montebello, CA www.pottorff-hvac.com.
 5. Prefco Products Inc, Buckingham, PA www.prefco-hvac.com.
 6. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.

7. Safe-Air / Dowco, Cicero, IL www.safeair-dowco.com.

2.4 FABRICATION

- A. General:
 1. 16 ga frames.
 2. Integral sleeves, except for Type 2 Fire Dampers.
- B. Type 1 Dampers: Fabricate with blades out of airstream.
- C. Type 3, 4, And 5 Dampers:
 1. Seals:
 - a. Blade seals shall be mechanically locked into blade edge. Clip-on and adhesive type seals are not acceptable.
 - b. Jamb seals shall be flexible metal compression type.
 2. Blades:
 - a. Type 3: 16 ga 1.59 mm minimum steel.
 - b. Type 4 And 5: 22 ga 0.79 mm minimum steel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Placement:
 1. Fire Dampers (Types 1 and 2): Install in ducts where ducts penetrate fire-rated walls and floors and at registers, grilles, and diffusers penetrating fire rated assemblies.
 2. Smoke Dampers (Type 3): Install smoke dampers in ducts within 24 inches 600 mm of where ducts penetrate smoke barriers.
 3. Standard Combination Fire / Smoke Dampers (Type 4): Install in ducts where ducts penetrate fire-rated smoke barriers.
 4. Corridor Combination Fire / Smoke Dampers (Type 5): Install in ducts where ducts penetrate fire-rated corridor ceilings.
- B. Sequences of Operation:
 1. Types 1 And 2: Dampers shall close when temperatures at damper exceed 165 deg F 74 deg C link unless indicated otherwise on Drawings.
 2. Type 3: Dampers shall close on signal from smoke detectors and on power failure.
 3. Types 4 And 5: Dampers shall close on signal from smoke detectors, on power failure, or when temperatures at damper exceed 165 deg F 74 deg C.

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.
 - 6. Titus, Richardson, TX www.titus-hvac.com.
 - 7. Tuttle & Bailey, Richardson, TX www.tuttleandbailey.com.

2.2 MANUFACTURED UNITS

- A. Ceiling Return And Transfer Grilles:
 - 1. Finish: Off-white baked enamel.
 - 2. 1/2 inch 13 mm spacing.
 - 3. 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: T70D.
- B. Floor / Toe Space Return Grilles:
 - 1. Finish: Clear anodized.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Carnes: CCJB (with mitered corners welded on face and sanded).

- b. J & J: 2500 with Frame 10.
 - c. Krueger: 1500F.
 - d. Nailor: 49-240-FN-MM.
 - e. Price: LBP-25B.
 - f. Titus: CT-540.
 - g. Tuttle & Bailey: LFD.
- C. Floor Supply Grilles:
- 1. Finish: Clear anodized.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Carnes: CCJB (with mitered corners welded on face and sanded).
 - b. J & J: 2500 with Frame 10.
 - c. Krueger: 1500F.
 - d. Nailor: 49-240-FN-MM.
 - e. Price: LBP-25B.
 - f. Titus: CT-540.
 - g. Tuttle & Bailey: LFD.
- D. 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: 90-L.
 - f. Titus: 33RL or 33RS.
 - g. Tuttle & Bailey: T110.
- E. 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: MS

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: Installation of architectural louvers not connected to ductwork.
 - 2. Section 23 3001: General Duct Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturer List:
 - 1. Airolite Co, Marietta, OH www.airolite.com.
 - 2. Air-Rite Manufacturing, Bountiful, UT (801) 295-2529.
 - 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.
 - 6. Industrial Louvers Inc, Delano, MN www.industriallouvers.com.
 - 7. Ruskin Manufacturing, Kansas City, MO www.ruskin.com.
 - 8. Vent Products Co Inc, Chicago, IL www.ventprod.com.
 - 9. 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 Drawings.
 - d. Finish:
 - 1) Polyvinylidene Fluoride (PVF₂) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF₂ 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) ELF81S30 by Ruskin.
 - 8) 2740-31 by Vent Products.
 - 9) 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) 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 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.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Furnace Filters: One inch 25 mm thick throw-away type as recommended by Furnace 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. Sections Under 09 9000 Heading: Painting.
 - 2. Section 23 0501: Common HVAC Requirements.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM D 1785-05, 'Standard Specification for Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.'
 - b. ASTM D 2564-02, 'Standard Specification for Solvent Cements for Poly(Vinyl Chloride)(PVC) Plastic Piping Systems.'
 - c. ASTM D 2661-02, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings.'
 - d. ASTM D 2665-04a, '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 D 1785, ASTM D 2661, or ASTM D 2665.
 - 2. Piping Primer And Cement: Meet requirements of ASTM D 2564.

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.
- B. Support:
1. Support concentric roof termination kit at ceiling or roof line with 20 ga sheet metal straps as detailed on Drawings.
 2. Support horizontal sections of pipe in accordance with requirements of Section 23 0501. Anchor securely to structure, not allowing pipe to sway.

END OF SECTION

SECTION 23 5417**PROPANE-FIRED FURNACES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Installed But Not Furnished Under This Section:
 - 1. Furnish and install horizontal/vertical propane-fired condensing furnaces as described in Contract Documents
- B. Related Sections:
 - 1. Section 23 0501: Common HVAC Requirements.
 - 2. Section 23 1123: Propane Gas Piping System.
 - 3. Section 23 2300: Refrigerant Piping System.
 - 4. Section 23 4100: Air Filters.

1.2 SUBMITTALS

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

1.3 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Provide 15 year minimum limited warranty of heat exchanger and 5 year limited warranty on parts.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

- A. Manufacturer:
 - 1. Manufacturer Contact List:
 - a. Carrier Corporation: Carrier National: Steven L. Ament 317-240-2938 steve.l.ament@carrier.utc.com Carrier Utah: Matt Smith 801-224-1020 msmith@mtncom.net
 - b. Lennox Industries: For pricing and information contact Lennox National Account @ 1-800-367-6285.
 - c. Trane: Trent Hunt 801-486-0500, trenthunt@trane.com.
 - d. York International: David E. Carey 405-419-6536 david.e.carey@jci.com.
- B. Performance:
 - 1. Design Criteria: Rated at 93 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 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 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. Approved Products:
 - 1) Standard Furnaces:
 - a) Carrier: 58MXB.
 - b) Lennox: G51MP.
 - c) Trane: TUX1/TDX1 or TUH1/TDH1.
 - d) York: TG9S.
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.
 - 4) Cooling coil for use with R410a refrigerant.
 - 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. 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 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, Hauppauge, 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. Install vibration isolator on each hanger rod supporting horizontal furnace and under each corner of vertical furnace.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service:
 - 1. Furnace installer shall:
 - a. Verify proper gas orifice size.
 - b. Clock gas meter for rated input.
 - c. Verify and set gas pressure at furnace.
 - d. Check and measure temperature rise.
 - e. Check safety controls for proper operation.
 - f. Check combustion vent sizes and combustion air sizes.
 - 2. 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 6213**AIR-COOLED REFRIGERANT CONDENSERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install condensing units as described in contract documents.
- B. Related Sections:
 - 1. Section 23 0501: Common HVAC Requirements.
 - 2. Section 23 2300: Refrigerant Piping System.

1.2 SUBMITTALS

- A. Informational Submittals:
 - 1. Tests and Evaluation Reports:
 - a. Manufacturer Reports: Equipment check-out sheets.
 - 2. Qualification Statements:
 - a. Technician certificate for use of CFC, HFC, and HCFC refrigerants.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Each unit shall be UL / ULC labeled.
- 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 CFC and HCFC refrigerants.

1.4 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Provide 10 year limited warranty on compressor and 5 year limited warranty on parts from date of 'start-up'. Record 'start-up' date on warranty certificate for each unit.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

- A. Manufacturer:
 - 1. Manufacturer Contact List:
 - a. Carrier Corporation: Carrier National: Steven L. Ament 317-240-2938. steve.l.ament@carrier.utc.com Carrier Utah: Matt Smith 801-224-1020 msmith@mtncom.net.
 - b. Lennox Industries: For pricing and information call Lennox National Account @ 1-800-367-6285.
 - c. Trane: Trent Hunt 801-486-0500, trenthunt@trane.com.
 - d. York International: David E. Carey 405-419-6536 david.e.carey@jci.com.

- B. Performance:
1. Capacities: SEER rating as defined by ARI shall be 13.0 or greater
- C. Manufactured Units:
1. Condensing Units:
 - 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.
 - i. Approved Products:
 - 1) Standard:
 - a) Carrier: 24ACB3.
 - b) Lennox: XC13.
 - c) Trane: 4TTB3.
 - d) York: YCHD or YCJD.

2.2 ACCESSORIES

- A. Vibration Isolators: 4 inches (100 mm) square by ¾ inches (19 mm) thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION**3.1 INSTALLATION**

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

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service:
 - 1. Condensing units shall be started up, checked out, and adjusted by condensing unit installer.
 - 2. Use equipment checkout sheet provided by Manufacturer. Complete and sign all items on sheet.

END OF SECTION

SECTION 23 8617**PROPANE FIRED UNIT HEATERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Furnish and install propane fired unit heaters as described in Contract Documents.

1.2 QUALITY ASSURANCE

- A. Units shall be AGA approved and suitable for propane gas.

1.3 WARRANTY

- A. Heat exchangers and draft hoods shall be guaranteed by manufacturer for a period of ten years under normal operating conditions.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Unit heaters shall have capacities shown on drawings.
- B. Heat exchangers shall be 18 gauge aluminized steel with 16 gauge aluminized steel header plates. Seams shall be electrically welded.
- C. Burners:
 - 1. Stainless steel ribbon inserts
 - 2. Fire directly into the heat exchanger tubes
 - 3. Easily opened access panel in the bottom of each heater for removal of individual burners and pilot assembly.
- D. Unit heaters (unless connected to ductwork) shall have four-way adjustable louvers for proper air diffusion.
- E. Each heater shall be equipped with:
 - 1. 24 volt automatic gas valve
 - 2. Automatic pilot with 100% safety shutoff
 - 3. Snap-acting high limit switch
 - 4. Gas pressure regulator
 - 5. Manual gas cock
- F. Blower models shall be equipped with 115/24 volt transformer and fan control.
- G. Heaters shall be controlled by a Honeywell T87F room thermostat.
- H. Approved Manufacturers:
 - 1. Lennox
 - 2. Reznor

END OF SECTION