

DIVISION 22: PLUMBING

22 0500 COMMON WORK RESULTS FOR PLUMBING

- 22 0501 COMMON PLUMBING REQUIREMENTS
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22 1000 PLUMBING PIPES AND PUMPS

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SECTION 22 0501**COMMON PLUMBING REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Common requirements and procedures for plumbing systems.
 - 2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
 - 3. Furnish and install sealants relating to installation of systems installed under this Division.
 - 4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

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

- C. Related Requirements:
 - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for exterior concrete pads and bases for mechanical equipment.
 - 2. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
 - 3. Section 07 8400: 'Firestopping' for quality of penetration firestop systems to be used on Project and submittal requirements.
 - 4. Section 07 9213: 'Elastomeric Joint Sealant' for quality at building exterior.
 - 5. Sections Under 09 9000 Heading: 'Paints And Coatings' for painting of plumbing items requiring field painting.
 - 6. Section 22 0548: 'Vibration And Seismic Control for Plumbing Piping and Equipment'.
 - 7. Division 26: 'Electrical' for raceway and conduit, unless specified otherwise, and line voltage wiring.
 - 8. 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.

- B. Informational Submittals:
 - 1. Qualification Statement:
 - a. Plumbing Subcontractor:
 - 1) Provide Qualification documentation if requested by Architect or Owner.

- b. Installer:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
 - 1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:
 - a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.
 - b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
 - (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
 - (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
 - c) Provide operating instructions to include:
 - (1) General description of fire protection system.
 - (2) Step by step procedure to follow for shutting down system or putting system into operation.
 - b. Warranty Documentation:
 - 1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 - 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
- B. Qualifications. Requirements of Section 01 4301 applies, but not limited to following:
 - 1. Plumbing Subcontractor:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in plumbing installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Accept valves on site in shipping containers with labeling in place.
 - 2. Provide temporary protective coating on cast iron and steel valves.
 - 3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Storage And Handling Requirements:
 - 1. In addition to requirements specified in Division 01, stored material shall be readily accessible for inspection by Architect until installed.
 - 2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.
- B. Special Warranty:
 - 1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 - 2. If plumbing 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 plumbing sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
 - 1. Weld-O-Let and Screw-O-Let fittings are acceptable.
- C. Sleeves:
 - 1. General:
 - a. Two sizes larger than bare pipe or insulation on insulated pipe.
 - 2. In Concrete And Masonry:
 - a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
 - 3. In Framing And Suspended Floor Slabs:
 - a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal.
- D. Valves:
 - 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers:

1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:

1. Plumbing Drawings show general arrangement of piping, 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 Plumbing 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 plumbing work is dependent for efficiency and report work that requires correction.
2. 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.
3. 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.
4. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

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 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 additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
4. Be responsible for proper location of rough-in and connections provided under other Divisions.

3.4 INSTALLATION

- A. Interface With Other Work:
 - 1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
 - 2. 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 confirm that they are properly installed.
- 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 and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
 - 2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
 - 3. Install plumbing 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 before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing 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 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. Penetration Firestops:
 - 1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.
- E. Sealants:
 - 1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
 - 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.
- F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
 - 1. 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 installation of plumbing systems.
 - 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.

- c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe 3/4 inch (19 mm) in diameter and smaller.
 - d. Install piping systems so they may be easily drained
 - e. Install piping to insure noiseless circulation.
 - f. 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.
3. Do not install piping in shear walls.
 4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
 5. 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.
 6. Make changes in direction with proper fittings.
 7. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet (9 meters) of straight run.
 - b. Provide 12 inch (300 mm) offset below roof line in each vent line penetrating roof.
 8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.
- G. Sleeves:
1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade.
 2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe penetrations through studs and floor slabs.
 3. 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.
 4. Sleeves through floors and foundation walls shall be watertight.
- H. Escutcheons:
1. Provide spring clamp plates 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.

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 plumbing piping systems. Furnish devices required for testing purposes.

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

3.7 CLEANING

- A. Remove dirt, grease, and other foreign matter from each length of piping before installation:
 - 1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
 - 2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
 - 3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.
- B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.8 CLOSEOUT ACTIVITIES

- A. Instruction of Owner:
 - 1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.
 - 2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.9 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.

END OF SECTION

SECTION 22 0529**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for plumbing systems.
- B. Products Installed But Not Furnished Under This Section:
 - 1. Paint identification for gas piping used in HVAC equipment.
- C. Related Requirements:
 - 1. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
 - 2. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 3. 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. Manufacturer Contact List:
 - a. Anvil International, Portsmouth, NH www.anvilintl.com.
 - b. Cooper B-Line, Highland, IL www.b-line.com.
 - c. Unistrut, Wayne, MI www.tyco-unistrut.com.
- B. Materials:
 - 1. Hangers, Rods, And Inserts
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - 1) Support insulated pipes 2 inches (50 mm) in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger: Anvil Fig. 69.
 - (2) Insulation Protection Shield: Anvil Fig. 167.
 - (3) Equals by Cooper B-Line.

- 2) Support insulated pipes 2-1/2 inches (64 mm) in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger: Anvil Fig. 260.
 - (2) Roller Assembly: Anvil Fig. 171.
 - (3) Insulation Protection Shield: Anvil Fig. 167.
 - (4) Equals by Cooper B-Line.
- 3) Support uninsulated copper pipe 2 inches (50 mm) in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
 - (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
 - (3) Equals by Cooper B-Line.
- 4) Support uninsulated copper pipe 2-1/2 inches (64 mm) in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
 - (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
 - (3) Equals by Cooper B-Line.
- c. 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	64 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

- d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	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						
Number	Diameter	50mm	64mm	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).
- e. Riser Clamps For Vertical Piping:
 - 1) Type Two Acceptable Products:
 - a) Anvil Fig. 261.
 - b) Equals by Cooper B-Line.
- f. Concrete Inserts:
 - 1) Individual Inserts:

- a) Suitable for special nuts size 3/8 inch (9.5 mm) through 7/8 inch (22 mm) with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
- b) Type Two Acceptable Products:
 - (1) Anvil Fig. 282.
 - (2) Equals by Cooper B-Line.
- 2) Continuous Inserts:
 - a) Class Two Quality Standard: Equal to Unistrut P-3200 series.
- g. Steel Deck Bracket:
 - 1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch (150 mm) length.

PART 3 - EXECUTION

3.1 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 Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches (2 400 mm) on center maximum for pipe 1-1/4 inches (32 mm) or larger and 72 inches (1 800 mm) on center maximum for pipe 1-1/8 inch (29 mm) or less.
 - 2) Support thermoplastic pipe at 48 inches (1 200 mm) on center maximum.
 - 3) Support PEX pipe at 32 inches (800 mm) minimum on center.
 - 4) 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.

END OF SECTION

SECTION 22 0553**IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS**2.1 SYSTEM**

- A. Materials:
1. Labels:
 - a. Equipment Identification:
 - 1) Black formica, with white reveal when engraved.
 - 2) Lettering to be 3/16 inch (5 mm) high minimum.
 2. Paint:
 - a. 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.
 - b. Finish Coats: Two coats 53 Line Acrylic Enamel.
 - c. Performance Standard: Paints specified are from Pittsburgh Paint & Glass (PPG), Pittsburgh, PA www.pittsburghpaints.com or PPG Canada Inc, Mississauga, ON (800) 263-4350 or (905) 238-6441.
 - d. Type Two Acceptable Products. See Section 01 6200.
 - 1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use. Maintain specified colors, shades, and contrasts.
 - a) Benjamin Moore, Montvale, NJ www.benjaminmoore.com or Toronto, ON (800) 304-0304 or (416) 766-1176.
 - b) ICI Dulux, Cleveland, OH or ICI Paints Canada Inc, Concord, ON www.dulux.com.
 - c) Sherwin Williams, Cleveland, OH www.sherwin-williams.com.

PART 3 - EXECUTION**3.1 APPLICATION**




- A. Labels:
1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
 - a. Water Heaters.
 2. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Room(s) served.
 - c. Panel and breaker from which unit is powered.
- B. Painting:

1. Only painted legends, directional arrows, and color bands are acceptable.
2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.
 - c. On each riser and junction.
 - d. Every 25 feet (7.6 m) on long continuous lines.
 - e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

A. Schedules:

1. Pipe Identification Schedule:
 - a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation	Direction of Flow
Domestic Cold Water	CW	
Domestic Hot Water	HW	
Domestic Recirc Water	HW Recirc	

END OF SECTION

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 1116: 'Domestic Water Piping'.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armacell, Mebane, NC www.armacell.com.
 - b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
 - c. IMCOA, Youngsville, NC www.nomacokflex.com.
 - d. Johns-Manville, Denver, CO www.jm.com.
 - e. Knauf, Shelbyville, IN www.knauffiberglass.com.
 - f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
 - g. Nomaco Inc, Yopungville, NC www.nomacokflex.com.
 - h. Owens-Corning, Toledo, OH www.owenscorning.com.
 - i. Speedline Corp, Solon, OH www.speedlinepvc.com.
- B. Materials:
 - 1. Above Grade Metal Piping:
 - a. Insulation For Piping:
 - 1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
 - 2) Insulation Thickness:

Service Water Temperature	Pipe Sizes		
	Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

Service Water Temperature	Pipe Sizes		
	Up to 32 mm	38 to 50 mm	Over 50 mm
77 - 82 Deg C	25 mm	38 mm	50 mm
60 - 71 Deg C	13 mm	25 mm	38 mm
7 - 54 Deg C	13 mm	13 mm	25 mm

- 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
- 4) Type One Acceptable Manufacturers:
 - a) Childers Products.
 - b) Knauf.
 - c) Manson.
 - d) Owens-Corning.

- e) Johns-Manville.
- f) Equal as approved by Architect before bidding. See Section 01 6200.
- b. Fitting, Valve, And Accessory Covers:
 - 1) PVC.
 - 2) Performance Standard: Zeston by Johns-Manville.
 - 3) Type One Acceptable Manufacturers:
 - a) Knauf.
 - b) Speedline.
 - c) Johns-Manville.
 - d) Equal as approved by Architect before bidding. See Section 01 6200.
- 2. Pex Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Above Grade Piping:
 - 1. Apply insulation to clean, dry piping with joints tightly butted.
 - 2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
 - 3. Piping up to 1-1/4 inch (32 mm) Diameter:
 - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
 - b. Adhere 3 inch (76 mm) wide self-sealing butt joint strips over end joints.
 - 4. Piping 1-1/2 inches (38 mm) Diameter And Larger:
 - a. Use broken-joint construction in application of two-layer covering.
 - b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
 - 1) Apply by hand in several layers to make up total specified thickness.
 - 2) Final layer shall have smooth uniform finish before application of covering.
 - 5. Fittings, Valves, And Accessories:
 - a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
 - b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
 - c. Piping Up To 1-1/4 Inch (32 mm) Diameter:
 - 1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
 - 2) Alternate Method:
 - a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two 1/8 inch (3 mm) wet coats of vapor barrier mastic reinforced with glass fabric extending 2 inches (50 mm) onto adjacent insulation.
 - d. Piping 1-1/2 inches (38 mm) To 2 Inches (50 mm):
 - 1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
 - 2) Apply final coat of fitting mastic over insulating cement.
 - e. Piping 2-1/2 inch (64 mm) And Larger:

- 1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
 - 2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
6. Pipe Hangers:
- a. Do not allow pipes to come in contact with hangers.
 - b. Pipe Shield:
 - 1) Provide schedule 40 PVC by 6 inch (150 mm) long at each clevis and/or unistrut type hanger.
 - 2) Provide 16 ga (1.64 mm) by 6 inch (150 mm) long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
 - 3) Provide 22 ga (0.85 mm) by 6 inch (150 mm) long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.
 - c. At Pipe Hangers:
 - 1) Provide rigid calcium silicate insulation (100 psi (690 kPA) compressive strength) at least 2 inches (50 mm) beyond shield.
7. 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 22 1116**DOMESTIC WATER PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Piping Requirements'.
 - 2. Section 22 0719: 'Plumbing Piping Insulation'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. American National Standards Institute / American Society of Sanitary Engineers:
 - a. ANSI/ASSE 1003-2009, 'Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems'.
 - b. ANSI/ASSE 1017-2009, 'Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems'.
 - c. ANSI/ASSE 1070-2015, 'Performance Requirements for Water Temperature Limiting Devices'.
 - 2. American Water Works Association:
 - a. AWWA C904-16, 'Cross-Linked Polyethylene (PEX) Pressure Pipe, 1/2 inch (12 mm) Through 3 inch (76 mm) for Water Service'.
 - 3. ASTM International:
 - a. ASTM B88-16, 'Standard Specification for Seamless Copper Water Tube'.
 - b. ASTM E84-18b, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
 - c. ASTM F876-17, 'Standard Specification for Crosslinked Polyethylene (PEX) Tubing'.
 - d. ASTM F877-18a, 'Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems'.
 - e. ASTM F1807-18a, 'Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing'.
 - f. ASTM F2023-15, "Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water'.
 - g. ASTM F2389-17a, 'Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems'.
 - h. CSA B356-10 (R2015), ' Water pressure reducing valves for domestic water supply systems'.
 - 4. NSF International Standard:
 - a. NSF P171, 'Protocol for Chlorine Resistance of Plastic Piping Materials' (1999).
 - 5. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 14-2018, 'Plastic Piping System Components and Related Materials'.
 - b. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
 - c. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's Literature:
 - 1) PEX pipe and PEX pipe fittings.
 - 2. Samples:
 - a. PEX pipe fitting.
- B. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - a. Written report of sterilization test.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Manufacturer's Warranty covering property damage caused by defective product including renovation costs or replacement costs.

PART 2 - PRODUCTS

2.1 SYSTEMS

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Aquatherm, Inc., Lindon, UT www.aquathermpipe.com.
 - b. Acorn Controls, City of Industry, CA www.acorneng.com
 - c. Cash Acme, Cullman, AL www.cashacme.com
 - d. Chicago Faucets, Des Plaines, IL, www.chicagofaucets.com.
 - e. Cla-Val Company, Costa Mesa, CA or Cla-Val Canada Ltd, Beamsville, ON www.cla-val.com.
 - f. Conbraco Industries Inc, Matthews, NC www.conbraco.com or Conbraco (Honeywell Ltd), Scarborough, ON (416) 293-8111.
 - g. Hammond Valve, New Berlin, WI www.hammondvalve.com.
 - h. Handy & Harmon Products Div, Fairfield, CT www.handyharmon.com or Handy and Harmon of Canada Ltd, Rexdale, ON (800) 463-1465 or (416) 675-1860.
 - i. Harris Products Group, Cincinnati, OH www.harrisproductsgroup.com.
 - j. Honeywell Inc, Minneapolis, MN www.honeywell.com.
 - k. Leonard Valve Co, Cranston, RI www.leonardvalve.com.
 - l. Milwaukee Valve Co, New Berlin, WI www.milwaukeevalve.com.
 - m. Nibco Inc, Elkhart, IN www.nibco.com.
 - n. Nupi Americas, Early Branch, SC www.nupiamericas.com.
 - o. Rehau, Leesburg, VA www.rehau-na.com.
 - p. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
 - q. Spence Engineering Co, Walden, NY www.spenceengineering.com.
 - r. Symmons Industries, Braintree, MA www.symmons.com.

- s. Uponor Inc, Apple Valley, MN www.uponor-usa.com.
 - t. Viega ProPress, Wichita, KS www.viega-na.com.
 - u. Watts Regulator Co, Andover, MA www.wattsreg.com.
 - v. Wilkins (Zurn Wilkins), Paso Robles, CA www.zurn.com.
 - w. Zurn PEX, Inc., Commerce, TX www.zurnpex.com.
- B. Materials:
- 1. Design Criteria:
 - a. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
 - b. No CPVC allowed.
 - 2. Pipe:
 - a. Copper:
 - 1) Above-Grade:
 - a) Meet requirements of ASTM B88, Type L.
 - b. Cross-Linked Polyethylene (PEX):
 - 1) Certified with NSF International against NSF Standards NSF/ANSI 14, NSF/ANSI 61, NSF/ANSI 372, and NSF P171 Protocol.
 - 2) Copper tube size (CTS) outside dimensions and Standard Dimension Ratio (SDR) of 9.
 - 3) Pressure rated for 160 psi (1.10 MPa) at 73 deg F (22.8 deg C), 100 psi (0.69 MPa) at 180 deg F (82 deg C), and 80 psi (0.552 MPa) at 200 deg F (93 deg C).
 - 4) Marked with Manufacturer's name, design pressure and temperature ratings, and third party certification stamp for NSF-PW.
 - 5) Manufactured by Engel or peroxide method (PEX-A) or by silane method (PEX-B).
 - 6) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) `Raupex by Rehau.
 - b) Wirsbo Aquapex by Uponor.
 - c) ViegaPEX by Viega.
 - d) Zurn PEX by Zurn PEX.
 - 3. Fittings:
 - a. For Copper Pipe: Wrought copper.
 - b. For PEX Pipe:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Everloc by Rehau.
 - b) Viega PEX Press Zero Lead Fittings with attached stainless steel sleeves or Viega PEX Press Radel-R Polymer with attached stainless steel sleeves by Viega.
 - c) ProPEX fittings by Uponor including EP flow-through multiport tees.
 - d) Zurn PEX XL, DZR and CR fittings.
 - 4. Connections For Copper Pipe:
 - a. Above-Grade:
 - 1) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
 - 2) Viega ProPress System
 - 5. Ball Valves:
 - a. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
 - b. Valves shall be two-piece, full port for 150 psi (1.03 MPa) SWP.
 - 1) Operate with flow in either direction, suitable for throttling and tight shut-off.
 - 2) Body: Bronze, 150 psig (1.03 MPa) wsp at 350 deg F (177 deg C) and 400 psig (2.76 MPa) wog.
 - 3) Seat: Bubble tight at 100 psig (0.69 MPa) under water.
 - c. Class One Quality Standard: Nibco T585 or S585.
 - 1) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Locate cold water lines a minimum of 6 inches (150 mm) from hot water line.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Before pipes are covered, test systems in presence of Architect/Engineer at 125 psig (0.86 MPa) hydrostatic pressure for four (4) hours and show no leaks.
 - 2. Disconnect equipment not suitable for 125 psig (0.86 MPa) pressure from piping system during test period.

3.3 CLEANING

- A. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect/Engineer. Allow sterilization solution to remain for twenty-four (24) hours and open and close valves and faucets several times during that time.
- B. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
- C. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished. END OF SECTION

SECTION 22 1313**FACILITY SANITARY SEWERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install soil, waste, and vent piping systems within building and connect.
- B. Related Requirements:
 - 1. Sections Under 07 3000 Heading: Furnishing and installing of roof jacks and pipe flashing at roof.
 - 2. Section 07 8400: 'Firestopping' for quality of firestopping material.
 - 3. Section 22 0501: 'Common Plumbing Requirements'.
 - 4. Section 22 1319: 'Facility Sanitary Sewer Specialties' for furnishing of sewer specialties.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 3111.

1.3 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM D2235-04(2016), 'Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'.
 - b. ASTM D2321-18, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
 - c. ASTM D2564-12(2018), 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
 - d. ASTM D3034-16, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
 - e. ASTM F628-12, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core'.
 - f. ASTM F656-15, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
 - g. ASTM F891-16, 'Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core'.
 - 2. International Code Council:
 - a. ICC IPC-2018, 'International Plumbing Code'.

PART 2 - PRODUCTS**2.1 SYSTEMS**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. American Brass & Iron (AB&I), Oakland, CA www.abifoundry.com.
 - b. Clamp-All Corp, Haverhill, MA www.clampall.com.
 - c. Anaco-Husky, Corona, CA www.anaco-husky.com.

- d. Josam Co, Michigan City, IN www.josam.com.
 - e. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com.
 - f. MG Piping Products Co, Stanton, CA www.mgcoupling.com.
 - g. Mifab Manufacturing Inc, Chicago, IL www.mifab.com.
 - h. Mission Rubber Co., Corona, CA www.missionrubber.com.
 - i. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
 - j. Watts Drainage, Spindale, NC www.watts.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
 - k. Zurn Cast Metals, Erie, PA or Zurn Industries Limited, Mississauga, ON www.zurn.com.
- B. Performance:
- 1. Design Criteria:
 - a. Minimum size of waste piping installed under floor slab on grade shall be 2 inches (50 mm).
 - b. Meet requirements of CAN/CSA-B70 for cast iron piping systems and CAN/CSA-B182.1 for plastic piping systems.
- C. Materials:
- 1. Piping And Fittings: PVC Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F891, joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
 - a. Furnish wall cleanouts with chrome wall cover and screw.
 - 2. Piping And Fittings: ABS Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F628, joined with pipe cement meeting requirements of ASTM D2235.
 - a. Furnish wall cleanouts with chrome wall cover and screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Thermoplastic Pipe And Fittings:
- 1. General: Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
 - 2. Above Grade: Locate pipe hangers every 4 feet (1.2 m) on center maximum and at elbows.
 - 3. Below Grade:
 - a. Install in accordance with Manufacturer's recommendations and ASTM D2321.
 - b. Stabilize unstable trench bottoms.
 - c. Bed pipe true to line and grade with continuous support from firm base.
 - 1) Bedding depth: 4 to 6 inches (100 to 150 mm).
 - 2) Material and compaction to meet ASTM standard noted above.
 - d. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
 - e. Trench width at top of pipe:
 - 1) Minimum: 18 inches (450 mm) or diameter of pipe plus 12 inches (300 mm), whichever is greater.
 - 2) Maximum: Outside diameter of pipe plus 24 inches (600 mm).
 - f. Do not use backhoe or power equipment to assemble pipe.
 - g. Initial backfill shall be 12 inches (300 mm) above top of pipe with material specified in referenced ASTM standard.
 - h. Minimum cover over top of pipe not under building slab:
 - 1) 36 inches (900 mm) before wheel loading.
 - 2) 48 inches (1 200 mm) before compaction.
- B. Install piping so cleanouts may be installed as follows:
- 1. At every 135 degrees of accumulative change in direction for horizontal lines.
 - 2. Every 100 feet (30 meters) of horizontal run.
 - 3. Extend piping to accessible surface. Do not install piping so cleanouts must be installed in carpeted floors. In such locations, configure piping so wall type cleanouts may be used.

- C. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system so gasses pass freely to atmosphere with no pressure or siphon condition on water seal.
- D. Vent entire waste system to atmosphere. Join lines together in fewest practicable numbers before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley. Vent line terminations shall be:
 - 1. 6 inches (150 mm) minimum above roof and 12 inches (300 mm) minimum from any vertical surface.
 - 2. Same size as vent pipe.
 - 3. In areas where minimum design temperature is below 0 deg F (minus 18 deg C) or where frost or snow closure may be possible:
 - a. Vent line terminations shall be same size as vent pipe, except no smaller than 2 inches (50 mm) in diameter.
 - b. Vents shall terminate 10 inches (250 mm) minimum above roof or higher if required by local codes.
- E. Furnish and install firestopping at penetrations of fire-rated structures as required under Sections 07 8400 and 22 0501.
- F. If test Tees are used for testing, plug Tees so wall finish can be installed. Do not leave as exposed cleanouts.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Conduct tests for leaks and defective work. Notify Architect before testing.
 - 2. Thermoplastic Pipe System:
 - a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or 10 feet (3 meters) minimum, and show no leaks for two hours. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

END OF SECTION

SECTION 22 1319**FACILITY SANITARY SEWER SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 09 3013: 'Ceramic Tile' for floor drains in ceramic tile floors.
 - 2. Section 22 0501: 'Common Plumbing Requirements'.
 - 3. Section 22 1119: 'Domestic Water Piping Specialties'.
 - 4. Section 22 1313: 'Facility Sanitary Sewers' for installation of miscellaneous sanitary sewer specialties.

PART 2 - PRODUCTS**2.1 SYSTEMS**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Josam Co, Michigan City, IN www.josam.com.
 - b. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com.
 - c. Mifab Manufacturing Inc, Chicago, IL www.mifab.com.
 - d. Proset Systems, Lawrenceville, GA www.prosetsystems.com.
 - e. Sioux Chief Manufacturing Co, Peculiar, MO www.siouxchief.com.
 - f. Sureseal Manufacturing, Tacoma WA www.thesureseal.com.
 - 1) Contact Information:
 - a) All Areas except Idaho and Utah: Rick Ensley (253) 564-0624, rick@thesureseal.com.
 - b) Idaho and Utah Areas: Mark Evans, phone (801) 748-1222, mark@franklinjames.com.
 - g. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
 - h. Watts Drainage, Spindale, NC www.watts.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
 - i. Zurn Industries, LLC, Erie PA www.zurn.com. or Zurn Industries Ltd, Mississauga, ON (905) 795-8844.
- B. Performance:
 - 1. Design Criteria:
 - a. All materials NOT required to be low lead compliant.
- C. Components:
 - 1. Drains And Drain Accessories:
 - a. Floor Drain FD-1:
 - 1) Approved types with deep seal trap and chrome plated strainer.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Josam: 30000-50-Z-5A.
 - b) J. R. Smith: 2010-A.
 - c) Mifab: F-1100-C.
 - d) Sioux Chief: 832.
 - e) Wade: 1100.

- f) Watts: FD-200-A.
- g) Zurn: Z-415.

D. Accessories:

1. Drain Accessories:

a. Condensate Receptor:

- 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Trap seal by Sureseal. Provide model number to match floor drain.

b. Floor Drains:

- 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Trap guard by Proset Systems. Provide model number to match floor drain.
 - b) Trap seal by Sureseal. Provide model number to match floor drain.

PART 3 - EXECUTION: Not Used

END OF SECTION

SECTION 22 4213**COMMERCIAL WATER CLOSETS AND URINALS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install plumbing fixtures as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
 - 2. Section 22 0501: 'Common Plumbing Requirements'.
 - 3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Definitions:
 - 1. High-Efficiency Toilet (HET): Toilets with effective flush volume of 1.28 gallons (4.8 liters) or less.
 - 2. Maximum Performance (MaP): Toilet testing that rates toilet efficiency and flush performance by measuring number of grams of solid waste (soybean paste and toilet paper) that a toilet can flush and remove completely from fixture in single flush represented as a scale or score. 1000 grams is highest score possible (www.map-testing.com).
- B. Reference Standards:
 - 1. American Society of Mechanical Engineers / CSA Group (Canadian Standards Association):
 - a. ASME A112.19.2-2018/CSA B45.1-18, 'Ceramic Plumbing Fixtures'.

1.3 SUBMITTALS

- A. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operation and Maintenance Data:
 - 1) Sensor Operated operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. American Standard Brands, Piscataway, NJ www.americanstandard-us.com or American Standard Canada, Mississauga, ON www.americanstandard.ca.
 - b. AMTC - Advanced Modern Technologies Corp, Woodland Hills, CA www.amtcorporation.com.
 - c. Bemis Manufacturing Co, Sheboygan Falls, WI www.bemismfg.com.
 - d. Beneke by Sanderson Plumbing Products, Columbus, MS www.sppi.com.

- e. Church Seat Co, Sheboygan Falls WI www.churchseats.com.
- f. Delany Flush Valves, Charlottesville, VA www.delanyproduct.com.
- g. Delta Faucet Co, Indianapolis, IN www.deltafaucet.com or Delta Faucet Canada, London, ON (519) 659-3626.
- h. Dearborn Brass, Cleveland, OH www.dearbornbrass.com.
- i. Gerber Plumbing Fixtures LLC, Woodridge, IL www.gerberonline.com.
- j. Josam Co, Michigan City, IN www.josam.com.
- k. Jay R. Smith Mfg. Co, Montgomery, AL www.jrsmith.com.
- l. Kohler Co Plumbing Div, Kohler, WI www.us.kohler.com.
- m. McGuire Manufacturing Co, Cheshire, CT www.mcquiremfg.com.
- n. Mifab Manufacturing Inc, Amherst, NY www.mifab.com.
- o. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON www.moen.com.
- p. Olsonite Corp, Newnan, GA www.olsonite.net or Olsonite Co Ltd, Tilbury, ON (519) 682-1240.
- q. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
- r. South Fork Manufacturing, Coalville, UT (801) 953-3001 www.dirt-grabber.com.
- s. Toto U.S.A., Inc., Morrow, GA www.totousa.com
- t. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
- u. Watts Drainage, Spindale, NC www.wattsdrainage.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
- v. Zurn Industries, LLC, Erie PA www.zurn.com. or Zurn Industries Ltd, Mississauga, ON (905) 795-8844.

B. Performance:

1. Design Criteria:

- a. Meet or exceed ASME A112.19.2/CSA B45.1 for Vitreous China Plumbing Fixtures.
- b. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
- c. All materials NOT required to be low lead compliant.
- d. Do not use toilets with effective flush volume of less than 1.28 gallons (4.8 liters).

C. Materials:

1. Water Closets:

- a. Floor Mounted With Tank:
 - 1) Standard Fixture:
 - a) Water usage of 1.6 gallons (6 liters) per flush.
 - b) MaP Score of 1000 grams.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Cadet 3 Elongated 215CA.004.
 - (2) Gerber: Avalanche AV-21-812.
 - (3) Kohler: Wellworth K-3978.
 - (4) Toto: 'Drake' CST744S.
 - 2) HET (High-Efficiency Toilet) - Standard Fixture:
 - a) Water usage of 1.28 gallons (4.8 liters) per flush.
 - b) Required HET fixtures for all California Projects.
 - c) MaP Score of 1000 grams.
 - d) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Cadet 3 Elongated 215CA.004.
 - (2) Gerber: Avalanche WS-21-812.
 - (3) Kohler: Wellworth K-3948.
 - (4) Toto: 'ECO Drake' CST744E.or CST744EG.
 - 3) Handicap Accessible Fixture:
 - a) Water usage of 1.6 gallons (6 liters) per flush.
 - b) 18 inch (450 mm) maximum rim height.
 - c) MaP Score of 1000 grams.
 - d) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Cadet 3 Right Height Elongated 215AA.004.

- (2) Gerber: Avalanche AV-21-818.
 - (3) Kohler: Highline K-3979.
 - (4) Toto: 'ADA Drake' CST744SL.
 - 4) HET (High-Efficiency Toilet) - Handicap Accessible Fixture:
 - a) Water usage of 1.28 gallons (4.8 liters) per flush.
 - b) 18 inch (450 mm) maximum rim height.
 - c) Required HET fixtures for all California Projects.
 - d) MaP Score of 1000 grams.
 - e) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Cadet Pro Right Height Elongated 215AA.104.
 - (2) Gerber: Avalanche WS-21-818.
 - (3) Kohler: Highline K-3949.
 - (4) Toto: 'ADA Drake' CST744EL.
- 2 Water Closet Accessories:
- a) Seats:
 - 1) Provide split front type with check hinges
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - b) Standard And Handicap Accessible Fixtures:
 - (1) American Standard: 5905.100SS.
 - (2) Bemis: 1655SSC.
 - (3) Beneke: 527 SS.
 - (4) Church: 9500SSC.
 - (5) Kohler: K-4731-C.
 - (6) Olsonite: 95SSC.
 - (7) Toto SC534.
 - c) Supply Pipe And Stop:
 - 1) Provide chrome plated quarter-turn brass ball valve, 12 inch (300 mm) braided stainless steel riser, and chrome-plated steel flange.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) McGuire: BV2166CC.
 - b) Zurn: Z8804.
3. Urinals:
- a) . HEU (High-Efficiency Urinal) - Standard Fixture:
 - 1) Water usage of 0.5 gallons (1.9 liters) per flush.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) American Standard: Washbrook FloWise 6590.001.
 - b) Gerber: Monitor 27-730.
 - c) Kohler: Bardon K-4904-ET.
 - d) Sloan SU-1009.
 - e) Toto: UT447E.
 - b) HEU (High-Efficiency Urinal) (If required by code and AHJ):
 - 3) Water usage of 0.125 gallons (pint) (0.47 liters) per flush.
 - 4) Required for all California Projects.
 - 5) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) American Standard: Washbrook FloWise 6590.001.
 - b) Kohler: Bardon K-4904-ET.
 - c) Sloan SU-1009.
 - d) Toto: UT445U.
4. Urinal Accessories:
- a. Carrier / Support:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Josam.
 - b) Jay R. Smith.
 - c) Mifab.
 - d) Wade.
 - e) Zurn.
 - b. Flush Valve:

- 1) HEU (High-Efficiency Urinal) - Standard:
 - a) Proximity sensor type with battery.
 - b) Low flow, 0.5 gallon (1.9 liters) per flush maximum.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard 6063.051.
 - (2) Delany: PL 1451-0.5.
 - (3) Delta: 81T231BTA factory set to 0.5 gallons per flush.
 - (4) Moen: 8315.
 - (5) Sloan: 8186-0.5.
 - (6) Zurn: ZER6003AV-EWS with maintenance override button.
- 2) HEU (High-Efficiency Urinal):
 - a) Required for all California Projects (If required by code and AHJ).
 - b) Proximity sensor type with battery.
 - c) Low flow, 0.125 gallons (pint) (0.47 liters) per flush maximum.
 - d) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard 6063.013.
 - (2) Delany: PL 1451-0.125PL.
 - (3) Delta: 81T231BTA-05 factory set to 0.125 gallons (0.5 liter) per flush.
 - (4) Moen: 8316.
 - (5) Sloan: 8186-0.125.
 - (6) Zurn: ZEMS6003AV-ULF-CP with maintenance override button.
- c. Flush Valve Filter:
 - 1) Required in following flush valves:
 - a) Sloan.
 - b) Zurn.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) SFDG1 'Dirt Grabber' by South Fork Manufacturing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install each fixture with separate vent line. Do not circuit vent.
- B. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.
 1. Seal wall-mounted fixtures around edges to wall with sealant specified in Section 07 9213 'Elastomeric Joint Sealants'.
 2. Attach wall-hung fixtures to carriers.
 3. Support fixture hanger or arm free of finished wall.
- C. Adjust flush valves for proper flow.
- D. Provide each individual fixture supply with accessible chrome-plated stop valve with hand wheel.
- E. Urinals: Install with accessible stop or control valve in each branch supply line.
- F. Mounting:
 1. Urinals:
 - a. Standard: 24 inches (610 mm) from floor to bottom lip.
 - b. Handicap Accessible: 17 inches (432 mm) maximum from floor to bottom lip.
- G. Water Closets:
 1. Floor or Wall Fixtures:

- a. Make fixture connections with approved brand of cast iron flange, soldered or caulked securely to waste pipe. Make joints between fixtures and flanges tight with approved fixture setting compound or gaskets. Caulk between fixtures with sealant specified in Section 07 9213. Point edges.
- H. Flush Valve Filters:
1. Install in Sloan and Zurn only flush valves.
 2. Install after water lines have been flushed out, but before turning water into flush valve.

3.2 CLEANING

- A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4216**COMMERCIAL LAVATORIES AND SINKS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install plumbing fixtures as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
 - 2. Section 22 0501: 'Common Plumbing Requirements'.
 - 3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. American National Standards Institute / International Code Council:
 - a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
 - 2. American Society of Mechanical Engineers / Canadian Standards Association (CSA Group):
 - a. ASME A112.18.1-2018/CSA B125.1-18, 'Plumbing Supply Fittings'.
 - b. ASME A112.19.1-2018/CSA B45.2-18, 'Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures'.
 - c. ASME A112.19.3-2017/CSA B45.4-17, 'Stainless steel plumbing fixtures'.
 - d. CSA B45.4-17/ASME A112.19.3-2017, 'Stainless Steel Plumbing Fixtures'.
 - 3. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
 - b. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.4 SUBMITTALS

- A. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Warranty Documentation:
 - 1) Final, executed copy of Warranty.

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Manufacturer's standard Warranty against material or Manufacturing defects.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:

1. Manufacturer Contact List:
 - a. American Standard Brands, Piscataway, NJ www.americanstandard-us.com or American Standard Canada, Mississauga, ON www.americanstandard.ca.
 - b. Brocar Products Inc, Cincinnati, OH www.brocar.com.
 - c. CECO, Huntington Park, CA www.cecosinks.com.
 - d. Chicago Faucet Co, Des Plaines, IL www.chicagofaucets.com.
 - e. Dearborn Brass, Tyler, TX www.dearbornbrass.com.
 - f. Delta Faucet Co, Indianapolis, IN www.deltafaucet.com or Delta Faucet Canada, London, ON (519) 659-3626.
 - g. Engineered Brass Co. (EBC) (Just Manufacturing Co.), Franklin Park, IL www.justmfg.com.
 - h. Elkay Manufacturing Co, Oak Brook, IL www.elkay.com.
 - i. Gerber Plumbing Fixtures LLC, Woodridge, IL www.gerberonline.com.
 - j. Josam Co, Michigan City, IN www.josam.com.
 - k. Jay R. Smith Manufacturing Co, Montgomery, AL www.jrsmith.com.
 - l. Just Manufacturing Co, Franklin Park, IL www.justsinks.com.
 - m. Keeney Manufacturing Co, Newington, CT www.keeneymfg.com.
 - n. Kindred USA, Midland, ON www.kindred-sinkware.com.
 - o. Kohler Co Plumbing Div, Kohler, WI www.us.kohler.com.
 - p. McGuire Manufacturing Co, Cheshire, CT www.mcquiremfg.com.
 - q. Mifab Manufacturing Inc, Amherst, NY www.mifab.com.
 - r. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON www.moen.com.
 - s. Omni Flow Controls, Harbor City, CA www.chronomite.com or www.omniflowcontrols.com.
 - t. Plumberex Specialty Products, Palm Springs, CA www.plumberex.com.
 - u. Sloan Valve Co, Franklin Park, IL www.sloanvalve.com.
 - v. Speakman Company, New Castle, DE www.speakmancompany.com.
 - w. Symmons, Braintree, MA www.symmons.com.
 - x. T & S Brass & Bronze Works Inc, Travelers Rest, SC www.tsbrass.com.
 - y. TrueBro Inc, Collierville, TN www.truebro.com.
 - z. Wade Div Tyler Pipe, Tyler, TX www.wadedrains.com.
 - aa. Watts Drainage, Spindale, NC www.wattsdrainage.com or Watts Industries, Burlington, ON, Canada www.wattscda.com.
 - bb. Zurn Commercial Brass, Sanford, NC www.zurn.com or Zurn Industries Ltd, Mississauga, ON (905) 795-8844.
 - cc. Zurn Cast Metal, Erie, PA www.zurn.com.

B. Performance:

1. Design Criteria:
 - a. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
 - b. Faucets and other fixture fittings shall conform to requirements of ASME A112.18.1/CSA B125.1.
 - c. Lavatories shall conform to requirements of:
 - 1) Enamelled cast iron and enamelled steel fixtures.
 - a) ASME A112.19.1/CSA B45.2.
 - b) CSA B45.2/ASME A112.19.1.
 - 2) Stainless steel plumbing fixtures:
 - a) ASME A112.19.3/CSA B45.4.
 - b) CSA B45.4/ASME A112.19.3.

C. Components:

1. Lavatories And Fittings:
 - a. Standard and Handicap Accessible Counter Top Lavatories:
 - 1) Size 20 by 17 inches (500 by 430 mm) nominal.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

- a) American Standard: Aqualyn 0476.028.
 - b) Gerber: Luxoval 12-844.
 - c) Kohler: Pennington K-2196-4N.
- b. Standard and Handicap Accessible Self Supporting Lavatories:
- 1) Size: 20 by 18 inches (500 by 450 mm) nominal.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) American Standard: Lucern 0355.012.
 - b) Kohler: Greenwich K-2032.
 - 3) Carrier / Support:
 - a) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Josam: 17100.
 - (2) Jay R. Smith: 0700.
 - (3) Mifab: MC-41.
 - (4) Wade: 520-M36.
- c. Lavatory Fittings:
- 1) Faucet and Grid Strainer For Standard Sinks:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Monterrey Two-Handle Centerset Lavatory Faucet with Vandal-Resistant Wrist Blade handles and grid strainer drain 5502.170.
 - (2) Chicago: 802CP with 327XCP.
 - (3) Delta: 2529HDF.
 - (4) Gerber: C4-44-412.
 - (5) Kohler: K-7404-5A with K-7715 strainer.
 - (6) Moen: 8215 with 14750 grid strainer.
 - (7) Speakman: SC 3072.
 - (8) T & S: B-0890 with B-0899 Grid Strainer.
 - (9) Zurn: Z81104 with McGuire 155A Grid Strainer.
 - 2) Faucet and Grid Strainer For Handicap Accessible Sinks:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) American Standard: Monterrey Two-Handle Centerset Lavatory Faucet with Vandal-Resistant Wrist Blade handles and grid strainer drain 5502.170.
 - (2) Chicago: 802-317CP with K7715 strainer.
 - (3) Delta: 2529HDF.
 - (4) Gerber: CO-44-412.
 - (5) Kohler: K-7404-5A with K-13885 strainer.
 - (6) Moen: 8215 with 14750 grid strainer.
 - (7) Speakman: SC 3074.
 - (8) T & S: B-0890 with B-0899 Grid Strainer.
 - (9) Zurn: Z-81104 with McGuire 155A grid strainer.
 - 3) Flow Control Fitting:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Accessories:
 - (1) Provide vandal-proof type in place of aerator. Flow shall be 0.5 gpm.
 - c) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - (1) Omni L-200 Series by Chromomite Laboratories.
 - 4) Supply pipes with stops:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Accessories:
 - (1) Provide chrome plated quarter-turn brass ball valve, 12 inches (305 mm) long braided stainless steel riser, and chrome-plated steel flange.

- c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) McGuire: BV2165CC.
 - (2) Zurn: Z8804 LRQ-PC.
 - 5) Trap:
 - a) Description:
 - (1) 17 gauge (1.4 mm) tube 'P' trap, chrome plated.
 - b) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Dearborn.
 - (2) Engineered Brass Company (EBC).
 - (3) Keeney Manufacturing.
 - (4) McGuire.
 - (5) Zurn.
 - 6) Safety Covers for Handicap Accessible Lavatories:
 - a) Description:
 - (1) Provide protection on water supply pipes and on trap.
 - b) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Trapwrap by Brocar Products Inc.
 - (2) Pro Wrap by McGuire Products.
 - (3) Lav Guard 2 by TrueBro.
 - (4) Pro Extreme by Plumberex.
- 2. Stainless Steel Sinks And Fittings:
 - a. Design Criteria:
 - 1) Not required to meet NSF International Standards for Lead Free.
 - 2) Self-rimming, 18 gauge (1.2 mm) stainless steel, satin finish.
 - b. Double Compartment Sinks:
 - 1) Design Criteria:
 - a) Not required to meet NSF International Standards for Lead Free.
 - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Elkay: LR 3319.
 - b) Just: DL-1933-A-GR.
 - c) Kindred: LBT 4408P-1.
 - c. Single Compartment Sink:
 - 1) Description:
 - a) Size: 22 by 19.5 inches (559 mm by 495 mm) nominal.
 - 2) Design Criteria:
 - a) Not required to meet NSF International Standards for Lead Free.
 - 3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Elkay: LR-2219.
 - b) Just: SL-1921-AG-R.
 - c) Kindred: LBS 4008P-1.
 - d. Stainless Steel Sink Fittings:
 - 1) Gooseneck Faucets for Compartment Serving Area Sinks:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Moen: 8227. (swivel).
 - (2) Speakman: SC-5724. (swivel).
 - 2) Faucets for Sacramento Preparation Room Sink:
 - a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

- (1) American Standard: Gooseneck Swivel Spout 7100.241H.
 - (2) Chicago: 350-ABCP.
 - (3) Delta: 27C643-R4.
 - (4) Gerber: C4-44-701.
 - (5) Kohler: K-7895-C.
 - (6) Moen: 8103.
 - (7) Speakman: SC-7112.
 - (8) T & S: 0305-01.
 - (9) Zurn: Z-825B1FC.
- 3) Faucets for Serving Area Sinks:
- a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Moen: 8227. (swivel).
 - (2) Speakman: SC-5724. (swivel).
- 4) Supply pipes with stops:
- a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Accessories:
 - (1) Provide chrome plated quarter-turn brass ball valve, 12 inches (300 mm) long braided stainless steel riser, and chrome-plated steel flange.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) McGuire: BV2165CC.
 - (2) Zurn: Z8804 LRQ-PC.
- 5) Flow Control Fitting:
- a) Design Criteria:
 - (1) Meet NSF International Standards for Lead Free.
 - b) Accessories:
 - (1) Provide vandal-proof type in place of aerator. Flow shall be 1.5 gpm.
 - c) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - (1) Omni A-200 Series by Chromomite Laboratories.
- 6) Waste For Standard Stainless Steel Sinks:
- a) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Elkay: LK-99.
 - (2) Kindred: 1130.
 - (3) Kohler: K8801.
 - (4) McGuire: 151.
 - (5) Zurn Z-8740-PC.
- 7) Waste For Sacrament Preparation Room Sink:
- a) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Elkay: LK18.
 - (2) Just: J-35FS.
 - (3) Kohler: K8807G.
 - (4) McGuire: 152.
 - (5) Zurn Z-8739-PC.
- 8) Trap:
- a) Description:
 - (1) 17 gauge (1.4 mm) tube 'P' trap, chrome plated.
 - b) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.

- c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Dearborn.
 - (2) Engineered Brass Company (EBC).
 - (3) Keeney Manufacturing.
 - (4) McGuire: MCT150075NCZN.
 - (5) Zurn.
- 3. Miscellaneous Sinks And Fittings:
 - a. Service Sink:
 - 1) Description:
 - a) Floor Type, enameled cast iron, 28 inches (711 mm) square with vinyl coated rim guard or 24 inches (610 mm) square with Stainless Steel rim guard.
 - 2) Design Criteria:
 - a) Not required to meet NSF International Standards for Lead Free.
 - 3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) American Standard: Florwell Enameled Cast Iron 7741.000 with vinyl rim guard 7745.811.
 - b) CECO: 871.
 - c) Kohler: Whitby K-6710.
 - d) Zurn: 5850.
 - 4) Service Sink Fittings:
 - a) Design Criteria:
 - (1) Not required to meet NSF International Standards for Lead Free.
 - b) Supply:
 - (1) Mounting height of 42 inches (1 050 mm).
 - (2) Provide 48 inch (1 200 mm) hose and clamp unless spout is threaded.
 - (3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (a) American Standard: Exposed Yoke Wall-Mount Utility Faucet with top brace 8344.112 with threaded spout.
 - (b) Chicago: 897 CP.
 - (c) Delta: 28T9 with 28T911 hose and bracket.
 - (d) Gerber: C4-44-654.
 - (e) Kohler: K-8928.
 - (f) Moen: 8124.
 - (g) Speakman: SC-5812.
 - (h) T&S: B-0665-BSTP.
 - c) Drain and Strainer:
 - (1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (a) American Standard: Grid strainer 7721.038.
 - (b) Kohler: K-9146, 3 inch IPS.
 - d) Trap: Cast iron, PVC, or ABS to match piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install each fixture with separate vent line. Do not circuit vent.
- B. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.
- C. Seal wall-mounted fixtures around edges to wall and counter top fixtures to countertop with sealant specified in Section 07 9213.

- D. Unless otherwise noted, provide each individual fixture supply with chrome-plated stop valve with hand wheel.
- E. Install fixtures with accessible stop or control valve in each hot and cold water branch supply line.
- F. Self-Supporting Lavatories: Install using carriers. Support carrier free of finished wall.
- G. Install Safety Covers on all under sink / lavatories with exposed water supply pipes and traps.
- H. Install Handicap Accessible Lavatories as per ADA height mounting requirements.

3.2 CLEANING

- A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4700**DRINKING FOUNTAINS AND WATER COOLERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install drinking water cooling system units as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. American National Standards Institute / International Code Council:
 - a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
 - 2. Canadian Standards Association (CA):
 - a. CSA C22.2 No. 120-13 (R2018), 'Refrigeration Equipment'.
 - 3. NSF International Standard / American National Standards Institute:
 - a. Bottle Filling Station:
 - 1) NSF/ANSI 42-2017, 'Drinking Water Treatments Units – Aesthetic Effects'.
 - 2) NSF/ANSI 53-2017, 'Drinking Water Treatments Units – Health Effects'.
 - b. Water Cooler:
 - 1) NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
 - 2) NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.
 - 4. Underwriters Laboratories (UL):
 - a. UL 399: 'Drinking-Water Coolers'.

1.3 SUBMITTALS

- A. Closeout Submittals:
 - 1. Warranty Documentation:
 - a. Provide Manufacturer Warranty.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Handicap Accessible Products to meet ANSI/ICC A117 Accessible requirements.
 - 2. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 3. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.5 WARRANTY

- A. Manufacturer standard limited warranty on refrigeration system of unit.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Manufacturers:
1. Manufacturer Contact List:
 - a. Elkay Manufacturing Co, Oak Brook, IL www.elkay.com.
 - b. Halsey Taylor, Oak Brook, IL www.halseytaylor.com.
 - c. Murdock Manufacturing (Acorn), City of Industry, CA www.murdockmfg.com.
 - d. Oasis, Tri Palm International, Columbus OH www.oasiswatercoolers.com.
- B. Design Criteria:
1. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
 2. Interior exposed pipe, valves, and fixture trim shall be chrome plated.
- C. Materials:
1. Handicap Accessible Bi-Level Cooler:
 - a. Design Criteria:
 - 1) Vandal proof operating bar on front and both sides.
 - 2) 8 GPH (30.3 LPH) water at 50 deg F (10 deg C) water cooled from 80°F (26.7°C) inlet water and 90°F (32.2°C) ambient per ASHRAE testing.
 - 3) 115-120 V, 60 Hz, single phase.
 - 4) Flexible bubbler.
 - 5) Build-In strainer.
 - 6) Meets state and federal requirements for both children or adults as defined by the Americans with Disabilities Act.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Elkay: Model EZSTL8LC.
 - 2) Halsey Taylor: Model HAC8FSBL-Q-ADA.
 - 3) Murdock Manufacturing: Model A172408B-UBL.
 - 4) Oasis: Model PG8ACSL.

2.2 HYDRATION STATION.

- A. Touchless sensor activated, 1.5 GPM Quick Fill, with automatic 20 second shut-off timer. 120V, 60 HZ single phase.
- B. Visual user interface display includes:
1. Innovative Green Ticker counting number of bottles saved from waste.
 2. Filter monitor indicating when replacement is needed.
- C. Water Sentry Plus Filler:
1. 3000 Gallon Capacity.
 2. Quick ¼ turn for easy installation.
 3. Polypropylene pre-filter mesh prevents coarse sediment from entering filter.
 4. Made with activated carbon and patented ATS lead-removal media.
 5. Final filter mesh prevents loose carbon from entering water.
 6. ANSI/NSF Standard 42 and 53.
- D. Approved Manufacturers:
1. Sunroc
 2. Halsey Taylor
 3. Haws
 4. Elkay
 5. Oasis
 - 1)

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install fixtures with accessible stop or control valve.
- B. Mounting:
 - 1. General:
 - a. Coordinate location of fountain with location and height of electrical outlet to ensure concealment of outlet by fountain.
 - b. Anchor bottom of fountain to wall.
 - c. Install 3/8 inch (9.5 mm) IPS union connection and Chicago No. 441 stop to building supply line.
 - d. Install 1-1/4 inch (32 mm) IPS slip cast brass 'P' trap. Install trap so it is concealed.
 - 2. Accessible Drinking Fountains:
 - a. Spout outlets of wheelchair accessible drinking fountains shall be 36 inches (915 mm) maximum above floor.
 - c. Spout outlets of drinking fountains for standing persons shall be 38 inches (965 mm) and 43 inches (1090 mm) maximum above floor.
 - d. Anchor bottom of fountain to wall.
 - e. Top surface to be 40 inches above floor.

3.2 CLEANING

- A. Polish chrome finish at completion of Project.

END OF SECTION

END OF DIVISION

DIVISION 23: HEATING, VENTILATING, AND
AIR-CONDITIONING

23 0500 COMMON WORK RESULTS FOR HVAC

- 23 0501 COMMON HVAC REQUIREMENTS
- 23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
- 23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- 23 0593 DUCT TESTING, ADJUSTING, AND BALANCING
- 23 0713 DUCT INSULATION
- 23 0719 HVAC PIPING INSULATION
- 23 0933 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

23 2000 HVAC PIPING AND PUMPS

- 23 2300 REFRIGERANT PIPING
- 23 2311 REFRIGERANT PIPE COVERS
- 23 2600 CONDENSATE DRAIN PIPING

23 3000 HVAC AIR DISTRIBUTION

- 23 3001 COMMON DUCT REQUIREMENTS
- 23 3114 LOW-PRESSURE METAL DUCTS
- 23 3300 AIR DUCT ACCESSORIES
- 23 3346 FLEXIBLE DUCTS
- 23 3400 EXHAUST FANS
- 23 3713 DIFFUSERS, REGISTERS, AND GRILLES

23 4000 HVAC AIR CLEANING DEVICES

- 23 4100 AIR FILTERS

23 6000 CENTRAL COOLING EQUIPMENT

- 23 6214 COMPRESSOR UNITS: AIR CONDITIONING (5 TON OR LESS)

23 8000 DECENTRALIZED HVAC EQUIPMENT

- 23 8216 AIR COILS: DX
- 23 8219 FAN COIL UNITS

END OF TABLE OF CONTENTS

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.

- 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 3111: 'Cast-In-Place Structural Concrete' for exterior concrete pads and bases for mechanical equipment.
 - 2. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 3. Section 07 9213: 'Elastometric Joint Sealant' for quality of sealants used at building exterior.
 - 4. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustical sealants.
 - 5. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.
 - 6. Section 26 2913: 'Enclosed Controllers' for magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
 - 7. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
 - 8. 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. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
 - 1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
 - a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.
 - b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
 - (1) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
 - (2) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
 - (3) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
 - c) Provide operating instructions to include:
 - (1) General description of each HVAC system.
 - (2) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
 - (3) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.
 - b. Warranty Documentation:
 - 1) Include copies of warranties required in individual Sections of Division 23.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
- B. Qualifications:
 1. Company:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in HVAC installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.
- B. Special Warranty:
 - 1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 - 2. If HVAC sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local HVAC sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
 - 1. Use domestic made pipe and pipe fittings on Project.
 - 2. Weld-O-Let and Screw-O-Let fittings are acceptable.
- C. Sleeves:
 - 1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
 - 2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
- D. Valves:
 - 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers:

1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:

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

B. Verification Of Conditions:

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

3.3 PREPARATION

A. Changes Due To Equipment Selection:

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

3.4 INSTALLATION

A. Interface With Other Work:

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

- B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.
- C. Locating Equipment:
1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
 2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
 3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
 4. Determine exact route and location of each pipe and duct before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.
- D. Piping:
1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
 - a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
 - b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
 - 1) Arrange so as to facilitate removal of tube bundles.
 - 2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified,
 - a) Make connections of dissimilar metals with di-electric unions.
 - b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - 3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
 - 4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
 - 5) Install piping to insure noiseless circulation.
 - 6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 - c. Do not install piping in shear walls.
 2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
 - b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 - c. Make changes in direction with proper fittings.
 - d. Expansion of Thermoplastic Pipe:
 - 1) Provide for expansion in every **30 feet (9 meters)** of straight run.
 - 2) Provide **12 inch (300 mm)** offset below roof line in each vent line penetrating roof.
 3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.

- a. Sleeves through floors shall extend **1/4 inch (6 mm)** above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
- b. Sleeves through floors and foundation walls shall be watertight.
4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
 - a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
 - b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
 - c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.
- E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.
- F. Sealants:
 1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.5 REPAIR / RESTORATION

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

3.6 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.
- B. Non-Conforming Work:
 1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
 2. Repeat tests on new material, if requested.

3.7 SYSTEM START-UP

- A. Off-Season Start-up:
 1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
 2. Notify Owner seven days minimum before scheduled start-up.
 3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
 4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.
- B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
 1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
 2. Make adjustments to insure that:

- a. Equipment alignments and clearances are adjusted to allowable tolerances.
 - b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
 - c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
 - d. Miscellaneous 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: Two (2) hours.
 - 2) Refrigeration: Two (2) 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 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
 - 2. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.
- C. Related Requirements:
 - 1. Section 23 0553: 'Identification For HVAC Piping And Equipment' for HVAC piping and equipment identification signage requirements.
 - 2. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.

1.2 ADMINISTRATIVE REQUIREMENTS

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

1.3 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

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

EXECUTION

2.2 INSTALLATION

A. Piping:

- 1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:

- 1) Support metal piping at **96 inches (2 400)** mm on center maximum for pipe **1-1/4 inches (32 mm)** or larger and **72 inches (1 800 mm)** on center maximum for pipe **1-1/8 inch (28 mm)** or less.
 - 2) Support thermoplastic pipe at **48 inches (1 200 mm)** on center maximum.
 - 3) Provide support at each elbow. Install additional support as required.
- c. Supports for Vertical Piping:
- 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
- d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
- e. Expansion of Thermoplastic Pipe:
- 1) Provide for expansion in every **30 feet (9 meters)** of straight run.
 - 2) Provide **12 inch (300 mm)** offset below roof line in each vent line penetrating roof.

END OF SECTION

SECTION 23 0553**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But not Installed Under This Section:
 - 1. Identification of HVAC piping and equipment as described in Contract Documents including:
- B. Related Requirements:
 - 1. Section 22 0529: 'Hangers And Supports For Plumbing' for field installation of pipe stencils and band colors for identification for piping used with HVAC equipment.

PART 2 - PRODUCTS**2.1 SYSTEMS**

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

PART 3 - EXECUTION**3.1 APPLICATION**

- A. Labels:
 - 1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
 - a. Thermostats and control panels in mechanical spaces (attach label to wall directly above or below thermostats).
 - b. Condensing units.
 - c. Fan coil units.

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install thermal wrap duct insulation as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 3114: 'Low-Pressure Metal Ducts'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MATERIALS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Thermal Wrap Duct Insulation:
 - 1. Install insulation as follows:
 - a. Within Building Insulation Envelope:
 - 1) **1-1/2 inches (38 mm)** thick on rectangular outside air ducts and combustion air ducts.
 - 2) **1-1/2 inches (38 mm)** thick on all round ducts.
 - 3) **1-1/2 inches (38 mm)** thick on all supply and return air ducts inside the building envelope.
 - b. Outside Building Insulation Envelope:

- 1) 3 inch (76 mm) thick on round supply and return air ducts.
 - 2) 1-1/2 inch (38 mm) thick on rectangular, acoustically lined, supply and return air ducts.
2. Wrap insulation tightly on ductwork with circumferential joints butted and longitudinal joints overlapped minimum 2 inches (50 mm).
- a. Do not compress insulation except in areas of structural interference. Minimum thickness at corners shall be one inch (25 mm) thick.
 - b. Remove insulation from lap before stapling.
 - c. Staple seams at approximately 16 inches (400 mm) on center with outward clenching staples.
 - d. Seal seams with foil vapor barrier tape or vapor barrier mastic. Seal penetrations of facing to provide vapor tight system.
- B. Insulate outside of ceiling diffusers, diffuser drops, and duct silencers same as ductwork.

END OF SECTION

SECTION 23 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 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.

3.2 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.

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 0719
HVAC PIPING INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: 'General HVAC Requirements'.
 - 2. Section 23 2300: 'Refrigerant Piping'.

1.2 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armacell, Mebane, NC www.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 or Owens-Corning Canada Inc, Willowdale, ON (416) 733-1600.
 - i. Ramco, Lawrenceville, NJ www.ramco.com.
 - j. Nomac, Zebulon, NC www.nomaco.com.
 - k. Speedline Corp, Solon, OH www.speedlinepvc.com.
- B. Materials:
 - 1. Refrigeration Piping System:
 - a. Thickness:

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

- 1) **One inch** sheet for fittings as recommended by Manufacturer.

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

Pipe Size, Outside Diameter	Insulation Thickness
25 mm and smaller	13 mm
29 to 50 mm	19 mm

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

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

SECTION 23 0933**ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY**

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

- B. Related Requirements:
 - 1. Section 23 0593: Duct testing, adjusting, and balancing of ductwork.
 - 2. Section 23 0501: Common HVAC Requirements.
 - 3. Section 23 3300: Furnishing and installing of temperature control dampers.
 - 4. Division 26:
 - a. Furnishing and installing of raceway, conduit, and junction boxes, including pull wires, for temperature control system except as noted above.
 - b. Power wiring to magnetic starters, disconnect switches, and motors.
 - c. Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SUBMITTALS

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

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

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

1.3 QUALITY ASSURANCE

- A. Qualifications: Requirements of Section 01 applies, but is not limited to the following:
 - 1. Installer:
 - a. Before bidding, obtain sponsorship from a local, Approved Distributor specified under PART 2 PRODUCTS of this specification. Initial requirements for sponsorship are:
 - 1) Receive LCBS Connect product training from Approved Distributor.
 - 2) Installer to provide Distributor sponsorship by submitting 'Certificate of Sponsorship' as Informational Submittal with bid. Certificate available as Attachment in this Specification.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:

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

B. Distributors: Obtain LCBS Connect control devices, RP panels, sensors, actuators and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301:

1. California:
 - a. Allied Refrigeration: (858) 213-3836 m.harreison@alliedrefrigeration.com Mike Harreison.
 - b. George T. Hall Co: (714) 397-4255 rpedersen@georgethall.com Bob Pedersen.
2. Hawaii:
 - a. Admor HVAC Products: (808) 841-7400 admorhvac@aol.com Drew Santos.
 - b. Automatic Controls: (808) 845-3443 acec_hi@lava.net Kurt Matsuzaki.
3. Utah:
 - a. Control Equipment Co: (800) 452-1457 rhowe@controlequiputah.com Ray Howe.
 - b. Relevant Solutions LLC: (801) 214-3313 Kathy.Wright@relevantsolutions.com Kathy Wright.

C. Performance:

1. Design Criteria:
 - a. Honeywell LCBS Connect control system with cloud based gateway:
 - 1) General Requirements:
 - a) Controls multistage equipment, dehumidification and ventilation with 2 wire connection to controller interface location in occupied space.
 - b) Adjustable backlight to controller interface module from 15%-100%en after 30 seconds of setting adjustments.
 - c) System controllers can be programmed from the interface module or from the cloud service.
 - d) LCBS Connect controller utilizes echelon communication network with the controller located near the mechanical equipment and the system interface located in the occupied space.
 - e) System shall control outdoor ventilation air based upon system occupancy of electric / electronic actuation of dampers.
 - f) CO2 sensors will open ventilation dampers only when CO2 exceeds 1200 ppm with ppm monitored by cloud service.
 - g) LCBS Connect devices access via internet Chrome browser via gateway.
 - h) Wired room temperature sensors may be added as specified.
 - 2) System Requirements:
 - a) Up to 3 Heat/2 Cool Heat Pumps; Up to 3 Heat/2 Cool Conventional Systems.
 - b) Tri-Lingual display (Selectable for English, Spanish, or French).
 - c) 18 to 30 Vac.
 - d) 50 Hz; 60 Hz.
 - e) System switch to include Auto changeover for Heat-Cool.
 - f) 7-Day Programming.
 - g) 365-Day Event Scheduling.
 - h) Display Security Lockout options.
 - i) Minimum/ Maximum Temperature Range Stops.

- j) Configurable over-ride option.
- k) Remote Access via internet.
- l) Dehumidification setting range 40 to 80% RH.

D. Components:

1. Controller, Wall Module:
 - a. Controller and Display Kit:
 - 1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - a) Part Number Honeywell YCRL6438SR1000 consisting of following:
 - (1) Unitary Controller: Honeywell CRL6438SR1000
 - (2) Wall Module: Honeywell TS120
 - b) Wall Cover Plate: Honeywell. 50002883-001.
 - c) Discharge Air / Return Air Sensors: Honeywell C7041B2005 20k ohms.
 - d) Outdoor Air Sensor: Honeywell C7041F2006.
 - e) Indoor Air Sensor:
 - (1) Sylk bus network; Honeywell TR40.
 - f) Averaging sensor:
 - (1) Sylk bus network; Honeywell TR40.
 - b. Internet Gateway Module(s): One (1) module per thirty (30) controllers.
 - 1) Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - a) LCBS Connect Gateway Module: Honeywell LGW1000.
2. Sealant Compound:
 - a. Description:
 - 1) Non hardening waterproof, vapor proof, self-adhesive for hot or cold application for sealing conduit openings against drafts, dust moisture and noise.
 - b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) Duct Seal Compound No. DS-130 by Gardner Bender, Menomonee Falls , WI.
www.gardnerbender.com.
 - 2) Thumb-Tite Sealing Compound No. 4216-92 by Nu-Calgon, St. Louis, MO
www.nucalgon.com.
3. 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 controller guard with integral wood base by Zimmerman Technologies.
 - 2) WMG 1 controller guard by Insul_Guard.
4. Duct Smoke Detectors:
 - a. Duct mounted smoke detector in systems with airflow greater than 2000 CFM.
 - b. Intelligent low flow photoelectric duct smoke detector with flash scan.
 - c. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) System Sensor Model D4120.
5. Transformer:
 - a. 120 / 24 V, 50VA Honeywell AT150F.
 - b. 120 / 24 V, 75VA Honeywell AT175F.
6. Damper Actuators:
 - a. Electric type equipped for Class I wiring.
 - b. Shall not consume power during Unoccupied cycle or use chemicals or expandable media.
 - c. Have built in spring return.
 - d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) Honeywell MS8105A1030/U.
 - 2) Honeywell MS8105A1130 w/ End switch.
7. Conductors:
 - a. Color-coded and No. 16 and No. 12 AWG Type TWN, TFN, or THHN, stranded.
 - b. Controller 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. Echelon Network Ebus Communicating Cable:
 - 1) Class Two Quality Standard. See Section 01 6200:
 - a) CAT 4, 22 gauge (0.025 in) (0.645 mm), twisted pair, non-plenum and non-shielded cable.
8. Local Relay (RP) Panels For Chapel And Cultural Center Systems:

- a. **16-ga (1.59 mm)** screw cover, painted sheet metal. Box with cover and knockouts, pre-wired terminal strips, relay, and transformer.
 - b. Provide Labels with Distributor contact information on each panel.
 - c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Heat Pump: LDS Model RP-6HP.
 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. Combination Equipment and Thermal Overload Switch Panel:
 - a. CEO panel must be provided by approved panel builder. See Section 01 6200 for definitions of Categories:
- E. Operation Sequences:
1. Programmable controller shall control Unoccupied and Occupied status of fan system based on adjustable seven-day program. 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 controller provides automatic change over between heating and cooling.
 3. Controller provides optional override by allowing timed override of program by pushing override on controller touch screen. This shall activate controller to Occupied Mode and system shall control to Occupied set point.
 4. Minimum outdoor ventilation air damper, spring return type, shall open in controller Occupied Mode and remain closed in Unoccupied Mode.
 5. Systems with CO₂ sensor to control minimum, spring return type, outdoor ventilation air damper:
 - a. Damper shall open in controller Occupied Mode only when CO₂ sensor setpoint of 1200 ppm is reached. Damper shall close if CO₂ level drops below 1100 ppm.
 - b. Damper shall remain closed in controller Unoccupied Mode.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers. See Section 01 4301:
1. Approved 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 controllers 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. Echelon Communication: Ebus
1. Ebus cable needs to be installed at least **12 inches (300 mm)** from **lighting, motors, or low voltage switching cables**
- 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. Field Tests:
 1. Calibrate, adjust, and set controls for proper operation, operate systems, and be prepared to prove operation of any part of control system. This work is to be completed before pre-substantial completion inspection.
 2. Test each individual heating, cooling, and damper control for proper operation using control system.

3.4 SYSTEM STARTUP

- A. For systems with LCBS Controller.
 1. Contractor is responsible for a fully functioning control system accessible via internet web browser. Contractor is responsible to coordinate Network start up with assistance from local IT technician. Local IT technician shall provide available ports on network switch for LCBS gateway.
 2. Contractor is responsible configuring all controllers with proper zone names, zone scheduling, proper Church conference / holiday scheduling, all to be coordinated with local FM manager. Set proper clock setting including day/month/year.
 3. Set Heating / Cooling to proper stages
 4. Set heat cycle rates to 9 cph and cooling to 4 cph.
 5. Set DO1 relay to "Occupancy".
 6. Set System switch operation to "Automatic" changeover.
 7. Set fan switch operation to "ON".
 8. Set minimum UnOcc start time for all days. No days shall be scheduled Unconfigured.
 9. Set Occupied start times to match meeting start times; provided by local FM manager.
 10. Place all zone over-ride durations to one (1) hour except for Bishop and Stake area which shall be set to two (2) hours.
 11. Set Occupied default heating setpoints to 70 degrees, cooling setpoints to 74 degrees.
 12. Set Unoccupied default heating setpoint to 60 degrees, cooling setpoints to 90 degrees.
 13. Set each zone to applicable Holiday scheduling for General & Stake Conferences.

3.5 ADJUSTING

- A. LCBS controller configuration settings; the following are configuration guidelines for consistent installations:
 1. Temperature Units Fahrenheit/ Celsius
 2. Equipment Type Conventional/heat pump.
 - a. Stages of Heat 1,2
 - b. Stages of Cool 1,2
 - c. Fan operation in heat mode Enable Fan w/ Heat
 3. Equipment Options
 - a. Leave at Default
 - b. Heating Cycles per Hour 6-9 cph
 - c. Cooling Cycles per Hour 3-4 cph
 4. Recovery
 - a. Leave at Default
 5. Economizer / DLC
 - a. Configure as required by control equipment.
 6. Sensor Selection
 - a. Set according to averaging sensors
 - b. Set to multi sensor "Smart" when averaging.
 - c. Set Occupancy Sensor to "Disable".
 7. Terminal Assignment
 - a. Set according to equipment

- b. Set Terminal DO1 to Occupancy to control fresh air damper based upon scheduled occupancy or over-ride.
8. Dehumidification
 - a. Leave at default
 - b. See Accessory Loops
9. Miscellaneous
 - a. Leave at default
10. Sensor setting
 - a. Leave at default
 - b. Set as Required
11. Accessory Loops – Set as required
 - a. Dehumidification
 - b. Other
12. Configure Zone Name (display on Home Screen).
13. Set Password to ABCD.
14. Set Occupied Setpoint
15. Set Unoccupied Setpoint
16. Set Schedule
17. MENU/ Holiday-Event Scheduler / Custom Events/ Create new event.
 - a. Hawaii Standard Time Zone
 - 1) First Sunday in April: Occupied Chapel from 8:30 am – 3:00 pm / every year.
 - 2) First Sunday in April: Unoccupied all other zones for all day / every year.
 - 3) First Sunday in October: Occupied Chapel from 8:30 am – 3:00 pm / every year.
 - 4) First Sunday in October: Unoccupied all other zones for all day / every year.

3.6 CLOSEOUT ACTIVITIES

- A. Instruction Of Owner:
 1. Include as part of training required in Section 23 0501, following training:
 - a. Training shall be by personnel of installing company and utilize operator's manuals and as-built documentation.
 - b. Provide training in (2) two sessions including LCBS Connect sight & smart Apps for up to six (6) hours total:
 - 1) First session will occur between system completion and Substantial Completion.
 - 2) Second session will occur within forty-five (45) days of Substantial Completion when agreed upon by Owner.
 - c. Training shall include sequence of operation review, selection of displays, modification of schedules and setpoints, troubleshooting of sensors, etc, as follows:
 - 1) Control System Overview:
 - a) Show access to system through both individual controllers and Internet browser and how network works. Scheduling building at minimum for Stake and General Conference, special events.
 - 2) Controller Programming from Keypad: Instructions on developing setpoints and schedules and adjusting local zone temperatures.
 - 3) Web Internet training with local Facilities Manager during two (2) sessions.
 - a) Review all features accessible from the 'Settings' tab including Alarm points, user access, scheduling and humidity setpoints (where applied).

END OF SECTION

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'.
 - 3. Section 23 6214: 'Compressor Units: Air Conditioning (5 Ton or less)'.
 - 4. Section 23 8216.01: 'Air Coils: DX'.
 - 5. Section 23 8219: 'Fan Coil Units'.

1.2 REFERENCES

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

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

- C. Reference Standards:
 - 1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.
 - 2. American National Standards Institute / American Welding Society:
 - a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 2011 ASHRAE Handbook - HVAC Applications.
 - 1) Chapter 48, 'Noise and Vibration Control'.
 - 4. ASTM International:
 - a. ASTM A36/A36M-14, 'Standard Specification for Carbon Structural Steel'.
 - b. ASTM B280-18, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.
 - 5. Canadian Standards Association:
 - a. CSA B52-18, 'Mechanical Refrigeration Code'.
 - 6. National Fire Protection Association / American National Standards Institute:

- a. NFPA 90A: 'Installation of Air-Conditioning and Ventilating Systems' (2018 or most recent edition adopted by AHJ).
- 7. Underwriters Laboratories:
 - a. UL 2182, 'Refrigerants' (April 2006).

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Show each individual equipment and piping support.
- B. Informational Submittals:
 - 1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Refrigerants:
 - a. Underwriters Laboratories / Underwriters Laboratories of Canada:
 - 1) Comply with requirements of UL 2182.
- B. Qualifications. Section 01 4301 applies, but is not limited to the following:
 - 1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

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

1. Refrigerant Piping:
 - a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
 - b. Do not use pre-charged refrigerant lines.
2. Refrigerant Fittings:
 - a. Wrought copper with long radius elbows.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
3. Tee Access:
 - a. Brass:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
4. Connection Material:
 - a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
 - 1) Copper to Copper Connections:
 - a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
 - 3) Do not use rods containing Cadmium.
 - b. Flux:
 - 1) Type Two Acceptable Products:
 - a) Stay-Silv White Brazing Flux by Harris Products Group.
 - b) High quality silver solder flux by Handy & Harmon.
 - c) Equal as approved by Architect before use. See Section 01 6200.
5. Valves:
 - a. Manual Refrigerant Shut-Off Valves:
 - 1) Ball valves designed for refrigeration service and full line size.
 - 2) Valve shall have cap seals.
 - 3) Valves with hand wheels are not acceptable.
 - 4) Provide service valve on each liquid and suction line at compressor.
 - 5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
 - 6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Henry.
 - b) Mueller.
 - c) Sherwood.
 - d) Virginia.
6. Filter-Drier:
 - a. On lines **3/4 inch (19 mm)** outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than **3/4 inch (19 mm)** outside diameter, filter-drier shall be sealed type with brazed end connections.
 - c. Size shall be full line size.
 - d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Emerson Climate Technologies.
 - 2) Mueller.
 - 3) Parker.
 - 4) Sporlan.
 - 5) Virginia.
7. Sight Glass:
 - a. Combination moisture and liquid indicator with protection cap.
 - b. Sight glass shall be full line size.
 - c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
 - d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) HMI by Emerson Climate Technologies.
8. Refrigerant Piping Supports:

- a. Base, Angles, And Uprights: Stainless steel meeting requirements of ASTM A36.
- b. Securing Channels:
 - 1) At Free-Standing Pipe Support:
 - a) Class One Quality Standard: P-1000 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 2) At Wall Support:
 - a) Class One Quality Standard: P-3300 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 3) At Suspended Support:
 - a) Class One Quality Standard: P-1001 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 4) Angle Fittings:
 - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- c. Pipe Clamps:
 - 1) Type Two Acceptable Manufacturers:
 - a) Hydra-Zorb.
 - b) ZSI Cush-A-Clamp.
 - c) Hilti Cush-A-Clamp.
 - d) Equal as approved by Architect before installation. See Section 01 6200.
- d. Protective Cover: 18 ga (1.2 mm) stainless steel.
- e. Provide and install on charging valves:
 - 1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
 - 2) Acceptable Manufacturers: Airtec.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refrigerant Lines:
 1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
 2. Slope suction lines down toward compressor **one inch/10 feet (25 mm in 3 meters)**. 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.
- D. Refrigerant Supports:
 1. Support Spacing:
 - a. Piping **1-1/4 inch (32 mm)** And Larger: **8 feet (2.450 m)** on center maximum.

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

3.2 FIELD QUALITY CONTROL

A. Field Tests:

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

B. Non-Conforming Work:

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

END OF SECTION

SECTION 23 2311**REFRIGERANT PIPE COVER****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.

PART 2- PRODUCTS**2.1 BASIC COVER**

- A. Basic refrigerant line cover shall be 18 gauge stainless 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.

PART 3- INSTALLATION

- 3.1 Do not use pop rivets. All fastening devices shall be plated screws and arranged so covers may be taken off for service.
- 3.2 Provide access opening for viewing the sight glass on the refrigerant line.

END OF SECTION

SECTION 23 2600**CONDENSATE DRAIN PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:

PART 2 - PRODUCTS**2.1 SYSTEMS**

- A. Materials:
 - 1. Condensate Drains:
 - a. Schedule 40 PVC for condensate drains from cooling coils.
 - 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less if required by local AHJ if required.
 - b. Use adhesive primer that has a VOC content of 550 g/L or less if required by local AHJ if required.
- 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.

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 23 0593 'Duct Testing, Adjusting, and Balancing' for ductwork.
 - 2. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustic sealant.
 - 3. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
 - a. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (4th Edition).

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Specification data on sealer and gauze proposed for sealing ductwork.
 - 2. Samples: Sealer and gauze proposed for sealing ductwork.
- B. Informational Submittals:
 - 1. Manufacturer Instructions:
 - a. Installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.

PART 2 - PRODUCTS**2.1 ASSEMBLIES**

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

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
- C. Hangers And Supports:
 1. Install pair of hangers as required by spacing indicated in table on Drawings.
 2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
 3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
 4. 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. Related Requirements:
 - 1. Section 23 0593: 'Duct Testing, Adjusting, And Balancing' for duct test, balance, and adjust air duct systems.
 - 2. Section 23 0713: 'Duct Insulation' for thermal Insulation for ducts, plenum chambers, and casings.
 - 3. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

- A. Association Publications:
 - 1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
 - 2. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (4th edition).
- B. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
 - b. ASTM E84-18b, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
 - 2. Underwriters Laboratories, Inc.:
 - a. UL 723: 'Standard for Safety Test for Surface Burning Characteristics of Building Materials'; (11th Edition - 2018).
 - 3. Underwriters Laboratories of Canada:
 - a. ULC 102-18: 'Method of Test for Surface Burning Characteristics of Building Materials and Assemblies' (ULC S102).

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Duct Sealer:
 - a. Meet Class A flame spread rating in accordance with ASTM E84 or UL 723.
 - b. Meet Class A flame spread rating in accordance with ULC-S102.2.
 - c. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Handling Requirements:
 - 1. Duct Sealer:
 - a. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).

- b. Handle to prevent inclusion of foreign matter, damage by water, or breakage.
- c. Store in a cool dry location, but never under **35 deg F (1.7 deg C)** or subjected to sustained temperatures exceeding **110 deg F (43 deg C)** or as per Manufacturer's written recommendations.
- d. Do use sealants that have exceeded shelf life of product.

1.5 FIELD CONDITIONS

A. Ambient Conditions:

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

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:

- 1. Sheet Metal:
 - a. Fabricate ducts, plenum chambers and casings of zinc-coated, lock-forming quality steel sheets meeting requirements A653/A653M, with G 60 coating.
- 2. Duct Sealer For Interior Ducts:
 - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Duct Butter or ButterTak by Cain Manufacturing Co Inc, Pelham, AL www.cainmfg.com.
 - 2) DP 1010, DP 1030 or DP 1015 by Design Polymerics, Fountain Valley, CA www.designpoly.com.
 - 3) PROseal, FIBERseal, EVERseal, or EZ-seal by Ductmate Industries, Inc., Charleroi, PA www.ductmate.com.
 - 4) SAS by Duro Dyne, Bay Shore, NY or Duro Dyne Canada, Lachine, QB www.durodyne.com.
 - 5) Iron Grip 601 by Hardcast Inc, Wylie, TX www.hardcast.com.
 - 6) MTS100 or MTS 200 by Hercules Mighty Tough, Denver CO, www.herculesindustries.com.
 - 7) 15-325 by Miracle / Kingco, Div ITW TACC, Rockland, MA www.taccint.com.
 - 8) 44-39 by Mon-Eco Industries Inc, East Brunswick, NJ www.mon-ecoindustries.com.
 - 9) Airseal Zero by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.
 - 10) Airseal #22 Water Base Duct Sealer by Polymer Adhesive Sealant Systems Inc, Weatherford, TX www.polymeradhesives.com.
- 3. Duct Sealer For Exterior Ducts:
 - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Two Part II Sealing System including RTA-50 liquid adhesive and DT-5300 for **3 inch (76 mm)** and DT 5400 for **4 inch (100 mm)** tape by Hardcast Inc, Wylie, TX www.carlislehvac.com.

B. Fabrication:

- 1. General:
 - a. Straight and smooth on inside with joints neatly finished.
 - b. Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck. Drops shall be same gauge as branch duct. Seal joints air tight.
- 2. Standard Ducts:
 - a. General:
 - 1) Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
 - b. Rectangular Duct:

- 1) Duct panels through **48 inch (1 200 mm)** dimension having acoustic duct liner need not be cross-broken or beaded. Cross-break unlined ducts, duct panels larger than **48 inch (1 200 mm)** vertical and horizontal sheet metal barriers, duct offsets, and elbows, or bead **12 inches (300 mm)** on center.
 - a) Apply cross-breaking to sheet metal between standing seams or reinforcing angles.
 - b) Center of cross-break shall be of required height to assure surfaces being rigid.
 - c) Internally line square and rectangular drops. Externally insulate round drops.
 - 2) Duct with height or width over **36 inches (900 mm)** shall be fabricated using SMACNA T-24 flange joints or of pre-fabricated systems as follows:
 - a) Ducts with sides over **36 inches (900 mm)** up to **48 inches (1 200 mm)**: Transverse duct joint system by Ductmate / 25, Elgen, Ward, or WDCI (SMACNA Class 'F' joint).
 - b) Ducts **48 inch (1 200 mm)** And Larger: Ductmate / 35, Elgen, or WDCI (SMACNA Class 'J' transverse joint).
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Ductmate Industries Inc, Charleroi, PA www.ductmate.com or Ductmate Canada Ltd, Burlington, ON (905) 332-7678.
 - (2) Ward Industries Inc, Bensonville, IL www.wardind.com.
 - (3) Elgen Manufacturing Company, Inc., East Rutherford, NJ www.elgenmfg.com.
- c. Round Duct:
- 1) Spiral Seam:
 - a) **28 ga (0.38 mm)** minimum for ducts up to and including **14 inches (355 mm)** in diameter.
 - b) **26 ga (0.46 mm)** minimum for ducts over **14 inches (355 mm)** and up to and including **26 inches (660 mm)** in diameter.
 - 2) Longitudinal Seam:
 - a) **28 ga (0.38 mm)** minimum for ducts up to and including **8 inches (200 mm)** in diameter.
 - b) **26 ga (0.46 mm)** minimum for ducts over **8 inches (200 mm)** and up to **14 inches (355 mm)** in diameter.
 - c) **24 ga (0.61 mm)** minimum for ducts over **14 inches (355 mm)** up to and including **26 inches (660 mm)** in diameter.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer as per Manufacturer's written instructions. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.
- B. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.
- C. Ducts shall not bear on top of structural members.
- D. Paint ductwork visible through registers, grilles, and diffusers flat black.
- E. Properly flash where ducts protrude above roof.
- F. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

1. Air Test and Balance Testing as specified in Section 23 : 'Duct Testing, Adjusting, and Balancing'.

B. Non-Conforming Work:

1. Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures at no additional cost to Owner.

END OF SECTION

SECTION 23 3300**AIR DUCT ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
 - b. ASTM C1071-16, 'Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)'.
 - c. ASTM C1338-14, 'Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings'.

PART 2 - PRODUCTS**2.1 ACCESSORIES**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. AGM Industries, Brockton, MA www.agmind.com.
 - b. Air Balance Inc, Holland, OH www.airbalance.com.
 - c. Air Filters Inc, Baltimore, MD www.afinc.com.
 - d. Air-Rite Manufacturing, Bountiful, UT (801) 295-2529.
 - e. American Warming & Ventilating, Holland, OH www.american-warming.com.
 - f. Arrow United Industries, Wyalusing, PA www.arrowunited.com.
 - g. Cain Manufacturing Company Inc, Pelham, AL www.cainmfg.com.
 - h. C & S Air Products, Fort Worth, TX www.csairproducts.com.
 - i. CertainTeed Corp, Valley Forge, PA www.certainteed.com.
 - j. Cesco Products, Florence, KY www.cescoproducts.com.
 - k. Daniel Manufacturing, Ogden, UT (801) 622-5924.
 - l. Design 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. Hercules Industries, Denver, CO, www.herculesindustries.com.

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

B. Materials:

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

- c) Kees: ADL-R.
 - d) Nailor: 0809.
 - e) Pottorff: RAD.
 - f) Ruskin: ADR.
 - g) Ward: DSA.
3. Dampers And Damper Accessories:
- a. Locking Quadrant Damper Regulators:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Duro Dyne: KS-385.
 - b) Dyn Air: QPS-385.
 - c) Elgen: EQR-4.
 - d) Ventfabrics: Ventline 555.
 - e) Young: No. 1.
 - b. Concealed Ceiling Damper Regulators:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Cain.
 - b) Duro Dyne.
 - c) Elgen.
 - d) Metco Inc.
 - e) Ventfabrics: 666 Ventlok.
 - f) Young: 301.
 - c. Volume Dampers:
 - 1) Rectangular Duct:
 - a) Factory-manufactured 16 ga (1.6 mm) galvanized steel, single blade and opposed blade type with 3/8 inch (9.5 mm) axles and end bearings. Blade width 8 inches (200 mm) maximum. Blades shall have 1/8 inch (3 mm) clearance all around.
 - b) Damper shall operate within acoustical duct liner.
 - c) Provide channel spacer equal to thickness of duct liner.
 - d) Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, furnish with concealed ceiling damper regulator and cover plate.
 - e) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Air-Rite: Model CD-2.
 - (2) American Warming: VC-2-AA.
 - (3) Arrow: OBDAF-207.
 - (4) C & S: AC40.
 - (5) Cesco: AGO.
 - (6) Daniel: CD-OB.
 - (7) Greenheck: VCD-20.
 - (8) Nailor: 1810 or 1820.
 - (9) Pottorff: CD-42.
 - (10) Ruskin: MD-35.
 - (11) United Enertech: MD-115.
 - (12) Utemp: CD-OB.
 - 2) Round Duct:
 - a) Factory-manufactured 20 ga (1.0 mm) galvanized steel, single blade with 3/8 inch (9.5 mm) axles and end bearings.
 - b) For use in outside air ducts.
 - c) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Air Balance: Model AC-22.
 - (2) Air-Rite: Model CD-8.
 - (3) American Warming: V-22.
 - (4) Arrow: Type-70.
 - (5) C & S: AC21R.
 - (6) Cesco: MGG.
 - (7) Nailor: 1890.
 - (8) Pottorff: CD-21R.
 - (9) Ruskin: MDRS-25.
 - (10) United Enertech: RD.

- d. Motorized Outside Air Dampers:
- 1) General:
 - a) Low leakage type. AMCA certified.
 - b) Make provision for damper actuators and actuator linkages to be mounted external of air flow.
 - 2) Rectangular Ducts:
 - a) Damper Blades:
 - (1) Steel or aluminum airfoil type with mechanically locked blade seals, 8 inch (200 mm) blade width maximum measured perpendicular to axis of damper.
 - (2) Jamb seals shall be flexible metal compression type.
 - (3) Opposed or single blade type.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Air Balance: AC 526.
 - (2) American Warming: AC526.
 - (3) Arrow: AFD-20.
 - (4) C & S: AC50.
 - (5) Cesco: AGO3.
 - (6) Nailor: 2020.
 - (7) Pottorff: CD-52.
 - (8) Ruskin: CD-60.
 - (9) Tamco: Series 1000.
 - (10) United Enertech: CD-150 or CD-160.
 - 3) Round Ducts:
 - a) Damper Blades:
 - (1) Steel with mechanically locked blade seals.
 - (2) Blade seals shall be neoprene or polyethylene.
 - (3) Single blade type.
 - b) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - (1) Air Balance: AC 25.
 - (2) American Warming: VC25.
 - (3) Arrow: Type 70 or 75.
 - (4) C & S: AC25R.
 - (5) Cesco: AGG.
 - (6) Nailor: 1090.
 - (7) Pottorff: CD-25R.
 - (8) Ruskin: CD25.
 - (9) Tamco: Square-to-Round Series 1000.
 - (10) United Enertech: RI.
4. Air Turns:
- a. Single thickness vanes. Double thickness vanes not acceptable.
 - b. 4-1/2 inch (115 mm) wide vane rail. Junior vane rail not acceptable.
5. Branch Tap for Flexible Ductwork:
- a. Factory-manufactured rectangular-to-round 45 degree leading tap fabricated of 24 ga (0.635 mm) zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A653, with G-90 coating.
 - b. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
 - c. Manual Volume Damper:
 - 1) Single blade, 22 ga (0.79 mm) minimum
 - 2) 3/8 inch (9.5 mm) minimum square rod with brass damper bearings at each end.
 - 3) Heavy-duty locking quadrant on 1-1/2 inch (38 mm) high stand-off mounting bracket attached to side of round duct.
 - d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) ST-1HD by Air-Rite:
 - a) Nylon damper bearings approved for Air-Rite.
 - 2) STO by Flexmaster.
 - 3) HET by Sheet Metal Connectors.

C. Fabrication:

1. 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. Flexible Connections: Install flexible inlet and outlet duct connections to each furnace.
- B. 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.
- C. 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.
 - d. Where concealed ceiling damper regulators are installed, provide cover plate.
 3. Install motorized dampers.

END OF SECTION

SECTION 23 3346**FLEXIBLE DUCTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 3001: Common Duct Requirements.

1.2 REFERENCES

- A. Reference Standards:
 - 1. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A: 'Installation of Air-Conditioning and Ventilating Systems' (2018 or most recent edition adopted by AHJ).
 - 2. Underwriters Laboratories:
 - a. UL 181, 'Factory-Made Ducts and Air Connectors' (11th Edition).
 - b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS**2.1 SYSTEM**

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. JP Lamborn Co., Fresno CA www.jpflex.com.
 - b. Flexmaster USA Inc, Houston, TX www.flexmasterusa.com or Flexmaster Canada Ltd, Richmond Hill, ON (905) 731-9411.
 - c. Thermaflex by Flexible Technologies, Abbeville, SC or Mississauga, ON www.thermaflex.net.
- B. Materials:
 - 1. Ducts:
 - a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
 - b. Insulation:
 - 1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
 - c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
 - d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) PR-25 by JP Lambornes.
 - 2) Flex-Vent KP by Thermaflex by Flexible Technologies.
 - 3) Type 1B Insulated by Flexmaster.
 - 2. Cinch Bands: Nylon, 3/8 inch (9.5 mm) removable and reusable type.
 - a. Listed and labeled in accordance with Standard UL 181B and labeled 'UL 181 B-C'.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install duct in fully extended condition free of sags and kinks, using 72 inch (1 800 mm) maximum lengths.
- B. Make duct connections by coating exterior of duct collar for 3 inches (75 mm) with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 3401**EXHAUST FANS****PART 1- GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
Furnish and install exhaust fans as described in Contract Documents.
- B. Related Requirements:
Section 23 3001: 'Common Duct Requirements'.
Division 26: Control device and electrical connection.

1.2 QUALITY ASSURANCE

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

PART 2- PRODUCTS**2.1 MANUFACTURERS**

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

2.2 MANUFACTURED UNITS

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

PART 3- EXECUTION

3.1 INSTALLATION

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

END OF SECTION

SECTION 23 3713**DIFFUSERS, REGISTERS, AND GRILLES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 3001: 'General Duct Requirements'.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

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

2.2 MANUFACTURED UNITS

- A. Ceiling Return And Transfer Grilles:
 - 1. Finish: Off-white baked enamel.
 - 2. **1/2 inch (12.7 mm)** spacing.
 - 3. See Contract Documents for location of filter grilles.
 - 4. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a. Carnes: RSLA.
 - b. J & J: S90H.
 - c. Krueger: S85H.
 - d. Nailor: 6155H.
 - e. Price: 535.
 - f. Titus: 355RL or 355 RS.
 - g. Tuttle & Bailey: T75D.
- B. Ceiling Diffusers:
 - 1. Finish: Off-white baked enamel.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:

- a. Carnes: SKSA.
 - b. J & J: R-1400.
 - c. Krueger: SH.
 - d. Nailor: 65OOB.
 - e. Price: SMD-6.
 - f. Titus: TDC-6.
 - g. Tuttle & Bailey: M.
- B. High Side Wall Return Grilles:
1. Finish: Off-white baked enamel.
 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a. Krueger: 5810.
 - b. Nailor: 51RC.
 - c. Price: RCG.
 - d. Titus: 1700.
 - e. Tuttle & Bailey: AVF.
- C. Side Wall Supply Grilles And Registers:
1. Finish: Off-white baked enamel.
 2. Removable core.
 3. Double deflection.
 4. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a. Krueger: 5815.
 - b. Metal*Aire: 42C.
 - c. Nailor: 51RCD.
 - d. Price: RCG-DVS.
 - e. Titus: 1707.
 - f. Tuttle & Bailey: AVF.

2.3 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.

2.4 ADJUSTING

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

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'.
 - 2. Section 23 8219: 'Fan Coil Units'.

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Fan Coil Unit Filters: **One inch (25 mm)** thick throw-away type as recommended by Fan Coil Unit 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 6214**COMPRESSOR UNITS: Air Conditioning (5 Ton or less)****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install compressor units as described in contract documents.
- B. Related Sections:
 - 1. Section 23 0501: 'Common HVAC Requirements'.
 - 2. Section 23 2300: 'Refrigerant Piping'.
 - 3. Section 23 8219: 'Fan Coil Units'.

1.2 REFERENCES

- A. Definitions:
 - 1. Compressor: Pump that increases vapor (refrigerant or air) pressure from one level to a higher level of pressure.
 - 2. Compressor Unit: Outside section of an air conditioning system which pumps vaporized refrigerant from the evaporator, compresses it, liquefies it in the condenser and returns it to the evaporator coil. The outdoor portion of a split system air conditioner contains the compressor and outdoor coil.
 - 3. Condenser: Device used to condense refrigerant in a cooling system.
 - 4. Condenser Coils: In a compressor unit, the coil dissipates heat from the refrigerant, changing the refrigerant from vapor to liquid.
 - 5. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
 - 6. SEER (Seasonal Energy Efficiency Ratio): Measure of cooling efficiency for air conditioners and heat pumps. A ratio of total cooling in comparison to electrical energy input in watts per hour. Higher the seer, the more energy efficient the unit. Since 2006, the minimum SEER required by the Department of Energy is 13.00 and 15.00+ SEER is considered high efficiency.
 - 7. Split System: Combination of an outdoor unit (air conditioner or heat pump) with an indoor unit (furnace or air handler). Split systems must be matched for optimum efficiency.
- B. Reference Standards:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute:
 - a. AHRI Standard 210/240-2017, 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).
 - 2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.
 - 3. ASTM International:
 - a. ASTM A615/A615M-18, 'Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement'.
 - b. ASTM C920-18, 'Standard Specification for Elastomeric Joint Sealants'.
 - 4. CSA Group (Canadian Standards Association):
 - a. CSA G30.18-09 (2014), 'Carbon Steel Bars for Concrete Reinforcement'.

1.3 SUBMITTALS

- A. Informational Submittals:
1. Tests and Evaluation Reports:
 - a. Manufacturer Reports: Equipment check-out sheets.
- B. Special Procedure Submittals:
1. Installer must register with Manufacturer before submitting Manufacturer Warranty:
 - a. Installer to contact Owner's Representative (FM Group or Project Manager) for following MANDATORY information to be given to Manufacturer before Manufacturer will issue Manufacturer's 'Special Church Warranty' included with Closing Submittal:
 - 1) This must be given to Manufacturer:
 - a) Name of Owner (name of FM Group) Bruce E. Vindinhar Diamond Head HI Facilities Management Group.
 - b) Mailing Address (FM office address) 95-1039 Meheula Parkway, Mililani, HI 96789
 - c) Building Property ID (unique 7 digit identifier) 513 1391
 - d) Project site address: 219 Lunalilo Home Road, Honolulu, HI 96825
 - e) Model Number of each Unit _____
 - f) Serial Number of each Unit _____
 - g) Date of Installation / Startup _____
 2. Qualification Statements:
 - a. Technician certificate for use in HFC and HCFC refrigerants.
- C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Warranty Documentation:
 - 1) Final, executed copy of Manufacturer's 'Special Church Warranty' including required Owner / Manufacturer mandatory information.
 - b. Record Documentation:
 - 1) Manufacturers Documentation:
 - a) Equipment checkout sheet: Complete and sign all items for each unit.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
1. Each unit shall be UL / ULC or ETL labeled.
 2. Comply with ANSI/AHRI Standard 210/240.
 3. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
- B. Qualifications. Section 01 4301 applies, but is not limited to the following:
1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

1.5 WARRANTY

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

PART 2 - PRODUCTS**2.1 ASSEMBLIES****A. Manufacturers:****1. Manufacturer Contact List:****a. Carrier Corporation:**

- 1) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carrier.utc.com.
- 2) Carrier Utah: Bret Adams (Contractors HVAC Supply) (801) 224-1020 ext. 2527
bret.adams@chcsut.com.

b. Lennox Industries:

- 1) For pricing and information call Lennox National Account at (800) 367-6285.
- 2) Lennox National Contact: Cody Jackson (801) 736-8904 Cody.Jackson@LennoxInd.com.

c. York International:

- 1) Brian Michael (405) 419-6230 brian.k.michael@jci.com.

B. Performance:

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

C. Manufactured Units:**1. Compressor Units (5 Tons or Less):****a. General:**

- 1) Use R-410a refrigerant.
- 2) 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.

f. Casing:

- 1) Fully weatherproof for outdoor installation. Finish shall be weather resistant with sea coast coating.

g. Openings shall be provided for power and refrigerant connections.**h. Panels shall be removable for servicing.****i. Category Four Approved Products. See Section 01 6200 for definitions of Categories:**

- 1) Carrier: 24ABB3.
- 2) Lennox: 13ACXN.
- 3) York: YCD.

2.2 ACCESSORIES

A. Vibration Isolators:

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:

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

3.2 INSTALLATION

A. General:

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

3.3 FIELD QUALITY CONTROL

A. Manufacturer Services:

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

END OF SECTION

SECTION 23 8216**AIR COILS: DX****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But Not Installed Under This Section:
 - 1. DX air coils as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: 'Common HVAC Requirements'.
 - 2. Section 23 2300: 'Refrigerant Piping'.
 - 3. Section 23 8219: 'Fan Coil Units'.

1.2 REFERENCES

- A. Definitions:
 - 1. DX (Direct Expansion): Use of refrigerant directly expanded into evaporation coils in supply air stream of an air conditioning unit.
 - 2. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
- B. Reference Standards:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute:
 - a. AHRI Standard 210/240-2017, 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).
 - 2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - a. ANSI/ASHRAE Standard 62.1-2016, 'Ventilation for Acceptable Indoor Air Quality' (ANSI Approved).SUBMITTALS
- C. Informational Submittals:
 - 1. Manufacturer Reports:
 - a. Equipment check-out sheets.
- D. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Manufacturers Documentation:
 - a) Equipment checkout sheet: Complete and sign all items for each unit.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. DX Coils:
 - a. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - 1) AHRI Certified.
 - b. American National Standards Institute / Air-Conditioning, Heating, and Refrigeration Institute
 - 1) Comply with requirements of ANSI/AHRI Standard 210/240.
 - c. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

- 1) Comply with requirements of ANSI/ASHRAE Standard 62.1, Section 5, 'Systems and Equipment' and Section 7, 'Construction and Startup'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer:

1. Manufacturer Contact List:
 - a. Carrier Corporation:
 - 1) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carrier.com.
 - 2) Carrier Utah: Bret Adams (**Contractors Heating/Cooling Supply**) (801) 224-1020 ext. 2527 bret.adams@mc.supply.
 - b. Lennox Industries:
 - 1) For pricing and information call Lennox Mountain Commercial at (800) 972-3283.
 - 2) Lennox National Contact: Jeff Barrett (801) 556-6114 jeff.barrett@lennoxind.com.
 - c. York (US Air Conditioning Distributors): Nick Filimoehala (801) 463-5323 n.filimoehala@us-ac.com

2.2 MANUFACTURED UNITS

A. DX Coils:

1. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match air handler.
 - a. Coil shall have aluminum fins bonded to seamless copper tubing.
 - b. Comply with ANSI/AHRI Standard 210/240. Provide drain pans with connections at one end.
 - c. Use thermal expansion valve with brazed joints In place of capillary tube metering device. Compression fittings not acceptable.
 - d. Provide Coils with Sea coat coating.
2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a. Horizontal:
 - 1) Carrier: CNPHP.
 - 2) Lennox: CHX35.
 - 3) York: CM
 - b. Vertical:
 - 1) Carrier: CNPVP.
 - 2) Lennox: CX35.
 - 3) York: CF.

PART 3 - EXECUTION

3.1 INSTALLATION

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

END OF SECTION

SECTION 23 8219**FAN COIL UNITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Products Furnished But Not Installed Under This Section:
 - 1. Fan coil units as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 23 0501: 'Common HVAC Requirements'.
 - 2. Section 23 2300: 'Refrigerant Piping' for system and fan coil unit installation.
 - 3. Section 23 4100: 'Air Filters'.

1.2 REFERENCES

- A. Association Publications:
 - 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 2015 ASHRAE Handbook, Chapter 48, 'Noise and Vibration Control'.
 - 2. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
 - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
 - 3. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - a. VISCMA 101-07, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
 - b. VISCMA 102-10, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
- B. Definitions:
 - 1. Air Handler: In a cooling only or heat pump system, an air handler (also called a fan coil depending on installation application) takes the place of an evaporator coil and the variable speed fan from a gas powered furnace. Air handlers extract heat from the air with refrigerant supplied by the air conditioner (or heat pump) in the summer and move heated air from the heat pump through the ductwork during colder weather.
 - 2. Blower: Air handling device for moving air in a ductwork distribution system. Also called a fan.
 - 3. DX (Direct Expansion): Use of refrigerant directly expanded into evaporation coils in supply air stream of an air conditioning unit.
 - 4. Fan Coil: See Air Handler.
 - 5. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
 - 6. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.
- C. Reference Standards:
 - 1. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - a. ANSI/ASHRAE Standard 62.1-2016, 'Ventilation for Acceptable Indoor Air Quality' (ANSI Approved).

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Air Handler / Fan Coil Units:
 - a. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - 1) AHRI Certified.
 - b. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - 1) Comply with requirements of ANSI/ASHRAE Standard 62.1.
 - c. Underwriters Laboratories / Underwriters Laboratories of Canada:
 - 1) Each unit shall be UL / ULC labeled.

1.5 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Provide five (5) year limited warranty on parts from date of 'start-up'.
 - 2. Record 'start-up' date on warranty certificate for each unit.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Air Handler / Fan Coil Units:
 - 1) Carrier Corporation:
 - a) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carrier.utc.com.
 - b) Carrier Utah: Bret Adams (Contractors HVAC Supply) (801) 224-1020 ext. 2527 bret.adams@chcsut.com.
 - 2) Lennox Industries:
 - a) For pricing and information call: Lennox National Account at 1-800-367-6285.
 - b) Lennox National Contact:
 - (1) Cody Jackson (801) 736-8904 Cody.Jackson@LennoxInd.com.
 - 3) York International:
 - a) Brian Michael (405) 419-6230 brian.k.michael@jci.com.
 - b. Supports:
 - 1) Unistrut, Div of Atkore International, Inc., Harvey, IL www.unistrut.com.
 - c. Vibration Isolators:
 - 1) Kinetics Noise Control Inc., Dublin, OH www.kineticsnoise.com.
 - 2) Mason Industries, Hauppauge, NY www.mason-ind.com.
 - 3) Vibration Mountings & Controls, Bloomingdale, NJ www.vmc-kdc.com.

B. Materials:

1. Blower Section:
 - a. Description:
 - 1) Modular system blower is mounted on separate DX coil.
 - b. Design Criteria:
 - 1) Blower section shall consist of cabinet, blower, and motor.
 - 2) Blower shall be Class 1, full DIDW, statically and dynamically balanced.
 - 3) Blower shall be direct driven with premium ECM variable speed motor or by PSC multispeed motor as specified on schedule.
 - 4) Airstream Surfaces: Surfaces In contact with the airstream shall comply with requirements In ASHRAE 62.1.
2. Fan Coil Units:
 - a. Description:
 - 1) Factory assembled units complete with blower section, DX coil section, steel casing, piped, and wired.
 - b. Design Criteria:
 - 1) Blower section shall consist of cabinet, blower, and motor:
 - a) Cabinet shall be of **22 ga (0.0299 in) (0.7595 mm)** minimum cold rolled steel and have finish coat of baked-on enamel.
 - b) Blower shall be Class 1, full DIDW (double inlet double width), statically and dynamically balanced.
 - c) Blower shall be direct driven with premium ECM (electronically commuted motors) variable speed motor.
 - d) Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 2) Provide access panels for servicing motor and fans.
 - c. Cooling Coil:
 - 1) DX type and factory equipped with following features:
 - a) Refrigerant line fittings which permit mechanical or sweat connections.
 - b) Thermal expansion valve refrigerant control.
 - c) Insulated steel condensate pan.
 - d) Provide with sea coast coating.
 - d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Multi-Speed Motor:
 - a) Carrier: FV4C006
 - b) Equal by Lennox:
 - c) Equal by York:

2.2 ACCESSORIES**A. Vibration Isolators:**

1. Horizontal Installation:
 - a. Design Criteria:
 - 1) Equipment requiring isolation shall be isolated as per recommended goals of 2011 ASHRAE Handbook, Chapter 48, Table 1, 'Design Guidelines for HVAC-Related Background Sound in Rooms'.
 - 2) Provide vibration isolators, base frames and inertia bases of sufficient size and design to assure that deflection and stability requirements are met. Isolators shall be provided to deflect uniformly under operating loads.
 - 3) Unless otherwise indicated, all equipment mounted on vibration isolated bases shall have minimum operating clearance of **2 inch (50 mm)** between the base and floor or support beneath.
 - 4) Steel components shall be cleaned of welding slag and coated with approved primer.
 - 5) Neoprene hanger type with load of **75 lbs (34 kg)** maximum.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Model RH by Kinetics.
 - 2) Model HD by Mason.
 - 3) Model RH by Vibration Mountings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Filter Frame:
 - 1. Build external to air handler as shown on Contract Drawings.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer Services:
 - 1. Use equipment checkout sheet provided by Manufacturer.
 - a. Complete and sign all items on sheet.

END OF SECTION

END OF DIVISION