

## **DIVISION 22: PLUMBING**

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

##### 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** 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.
  - 2. Use domestic made pipe and pipe fittings on Project, except non-domestic made cast iron pipe and fittings by MATCO-NORCA 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 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** 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.
- 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. .
  3. Sleeves through floors shall extend **1/4 inch** 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.

##### 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](http://www.anvilintl.com).
    - b. Cooper B-Line, Highland, IL [www.b-line.com](http://www.b-line.com).
    - c. Unistrut, Wayne, MI [www.tyco-unistrut.com](http://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** 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) Acceptable Products:
          - (1) Swivel Ring Hanger: Anvil Fig. 69.
          - (2) Insulation Protection Shield: Anvil Fig. 167.
          - (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

- 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

2	3/8 Inch	Two	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0
2	5/8 Inch	Six	Four	Three	Two	0
2	5/8 Inch	Nine	Seven	Five	Three	Two
2	5/8 Inch	Twelve	Nine	Seven	Five	Three

- 1) Size trapeze angles so bending stress is less than 10,000 psi.
- e. Riser Clamps For Vertical Piping:
  - 1) 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 through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
    - b) Acceptable Products:
      - (1) Anvil Fig. 282.
      - (2) Equals by Cooper B-Line.
  - 2) Continuous Inserts:
    - a) Quality Standard: Equal to Unistrut P-3200 series.
- g. Steel Deck Bracket:
  - 1) Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch 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 on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
      - 2) Support thermoplastic pipe at 48 inches on center maximum.
      - 3) Support PEX pipe at 32 inches 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 0548

### VIBRATION AND SEISMIC CONTROL FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

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

##### 1.2 REFERENCES

- A. Association Publications:
  - 1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
    - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
  - 2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
    - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
    - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
- B. Definitions:
  - 1. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.
- C. Reference Standards:
  - 1. American National Standards Institute / Sheet Metal And Air Conditioning Contractors' National Association:
    - a. ANSI/SMACNA 001-2008, 'Seismic Restraint Manual: Guidelines For Mechanical Systems' (3rd Edition).
  - 2. American Society of Civil Engineers / Structural Engineering Institute:
    - a. ASCE/SEI 7-10, 'Minimum Design Loads for Buildings and Other Structures'.
      - 1) Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
  - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
    - a. 2011 ASHRAE Handbook - HVAC Applications.
      - 1) Chapter 48, 'Noise and Vibration Control'.
      - 2) Chapter 55, 'Seismic- and Wind-Resistant Design'.
  - 4. ASTM International:
    - a. ASTM A615/A615M-12, 'Standard Specification for Deformed & Plain Billet-Steel Bars for Concrete Reinforcement'.

##### 1.3 SUBMITTALS

- A. Action Submittals:
  - 1. Product Data:
    - a. Restraint system and anchorage method to be used for each piece of equipment.
    - b. Seismic restraints and calculations for all flexible mounted equipment.
    - c. Vibration isolators and flexible couplings.
    - d. Clearly outlined procedures for installing and adjusting isolators, seismic bracing anchors, and snubbers.
  - 2. Shop Drawings:
    - a. Show size, hanger length, and location of seismic restraints for piping and ductwork.

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

## 1.4 QUALITY ASSURANCE

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

## PART 2 - PRODUCTS

### 2.1 SYSTEMS

- A. Manufacturers:
  - 1. Acceptable Manufacturers:
    - a. Amber / Booth Company, Houston, TX [www.amberbooth.com](http://www.amberbooth.com).
    - b. Mason Industries Inc, Hauppauge, NY [www.mason-ind.com](http://www.mason-ind.com).
    - c. Vibration Mountings and Control Inc, Bloomington, NJ (201) 838-1780.
    - d. Equal as approved by Architect before bidding. See Section 01 6200.
- B. Performance:
  - 1. Design Criteria:
    - a. Seismic Requirements: Mechanical equipment, piping, and ductwork shall be braced, snubbed, or supported to withstand seismic disturbances and remain operational.
    - b. Vibration Isolation Requirements: Isolate equipment from structure by means of resilient vibration and noise isolators.
- C. Materials:
  - 1. Isolation And Seismic Equipment:
    - a. Piping:
      - 1) Restrain piping in accordance with ANSI/SMACNA 001 Seismic Restraint Manual, Chapter 4, Figures 4.11 to 4.19.
    - b. Equipment with Fixed Anchor or Support:
      - 1) Restraint designed according to ASCE/SEI 7-10, Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
      - 2) Horizontal force factor for elements of structures:
        - a) In addition, vertical force restraint requirement shall be computed at 1/2 value of horizontal forces.

- b) Restrain equipment not anchored directly to floors by cable system designed and furnished by Restraint Manufacturer.
  - 2. Vibration Isolation Requirements:
    - a. Unless otherwise noted, isolate plumbing equipment one horsepower and over from structure by means of resilient vibration and noise isolators in accordance with ASHRAE 'Handbook - HVAC Applications', Chapter 48, Table 47, 'Selection Guide for Vibration Isolation'.
    - b. Design and install isolation equipment, hangers, connections, and other isolating devices to prevent transmission of vibration to structure from equipment and associated piping and ductwork.
    - c. For floor-mounted equipment, use recommendations of Chapter 48, Table 47, 'Selection Guide for Vibration Isolation'.
    - d. For roofs and floors constructed with open web joints, thin long span slabs, wooden construction and unusual light weight construction, evaluate equipment weighing more than **300 lbs** to determine additional deflection of structure caused by equipment weight. Isolator deflection shall be 15 times additional deflection or deflection shown in Chapter 48, Table 47, 'Selection Guide for Vibration Isolation', whichever is greater.
    - e. Under-Equipment Spring Isolators:
      - 1) Equal to Mason SSLFH earthquake motion restrained spring mounts with freestanding stable steel springs, leveling bolts, corrosion resistant finish, motion limiting design, uplift restraining bolts, and **1/4 inch** ribbed neoprene noise stop pad.
      - 2) Isolators shall accept force in any direction up to 1.0 g without failure, and shall limit movement to **3/4 inch** in any direction.
      - 3) Springs shall have 50 percent overload capacity.
      - 4) Size as required to achieve specified static deflection.
      - 5) Outer diameter of spring proper shall not be less than **0.08 inch** of spring height when in loaded position.
    - f. Overhead Support Spring And Rubber Hangers:
      - 1) Combination spring and neoprene hangers.
      - 2) Hanger bracket shall have 500 percent overload capability and shall allow up to 15 degree hanger rod misalignment without short-circuiting.
      - 3) Springs shall have 50 percent overload capacity.
      - 4) Provide seismic bracing as required.
    - g. Isolate piping and ductwork in mechanical equipment room and piping and ductwork three supports away or **50 feet** from other mechanical equipment, whichever is greater, from structure by means of vibration and noise isolators:
      - 1) Isolate suspended piping with combination spring and fiberglass hangers in supporting rods.
      - 2) Support floor-mounted piping directly on spring mounts.
    - h. Isolate vertical pipe risers from structure using vibration and noise isolating expansion hangers having minimum rated deflection of four times anticipated pipe movement. Enclose in housing for fail-safe equipment.
    - i. Incorporate flexible connectors in piping adjacent to reciprocating equipment.
    - j. Incorporate flexible connections in ductwork adjacent to air-moving units.
    - k. Elastomeric Isolator: Neoprene or high quality synthetic rubber with anti-ozone and anti-oxidant additives.
    - l. Nuts, Bolts, And Washers: Electroplated zinc.
    - m. Isolators Exposed To Weather: Cadmium plated and neoprene coated springs.
  - 3. Seismic restraint equipment and resilient isolation devices shall be designed and furnished by single Manufacturer.
- D. Finishes:
- 1. Clean and paint steel components:
    - a. Thoroughly clean structural steel bases of welding slag and prime with zinc-chromate or metal etching primer.
    - b. Etch and paint hot dipped galvanized steel components.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Isolation Equipment:

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

#### B. Vibration Isolation:

1. Install piping and ductwork to prevent transmission of noise and vibration into structure.

**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 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](http://www.pittsburghpaints.com) or PPG Canada Inc, Mississauga, ON (800) 263-4350 or (905) 238-6441.
    - d. 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](http://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](http://www.dulux.com).
        - c) Sherwin Williams, Cleveland, OH [www.sherwin-williams.com](http://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** 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
Domestic Cold Water	CW
Domestic Hot Water	HW

**END OF SECTION**

## SECTION 22 0719

### 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.
  - 2. Furnish and install insulation on roof drain piping 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](http://www.armacell.com).
    - b. Childers Products Co, Eastlake, OH [www.fosterproducts.com](http://www.fosterproducts.com).
    - c. IMCOA, Youngsville, NC [www.nomacokflex.com](http://www.nomacokflex.com).
    - d. Johns-Manville, Denver, CO [www.jm.com](http://www.jm.com).
    - e. Knauf, Shelbyville, IN [www.knauffiberglass.com](http://www.knauffiberglass.com).
    - f. Manson, Brossard, PQ, Canada [www.isolationmanson.com](http://www.isolationmanson.com).
    - g. Nomaco Inc, Yopungsville, NC [www.nomacokflex.com](http://www.nomacokflex.com).
    - h. Owens-Corning, Toledo, OH [www.owenscorning.com](http://www.owenscorning.com).
    - i. Speedline Corp, Solon, OH [www.speedlinepvc.com](http://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
      - 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
      - 4) 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) Acceptable Manufacturers:
  - a) Knauf.
  - b) Speedline.
  - c) Johns-Manville.
  - d) Equal as approved by Architect before bidding. See Section 01 6200.
2. Below Grade Metal Piping:
  - a. Insulation:
    - 1) **1/2 inch** thick.
    - 2) 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) 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** Diameter:
    - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
    - b. Adhere **3 inch** wide self-sealing butt joint strips over end joints.
  4. Piping **1-1/2 inches** 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** 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** wet coats of vapor barrier mastic reinforced with glass fabric extending **2 inches** onto adjacent insulation.
    - d. Piping **1-1/2 inches** To **2 Inches**:
      - 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** 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. Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
    - c. Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.
  - 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.
- B. Below Grade Piping:
- 1. Slip underground pipe insulation onto pipe and seal butt joints.
  - 2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

**END OF SECTION**

## SECTION 22 1116

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Perform excavating and backfilling required by work of this Section.
  - 2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines **5 feet** from building perimeter 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, '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 E84-15b, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
    - b. ASTM F876-15a, 'Standard Specification for Crosslinked Polyethylene (PEX) Tubing'.
    - c. ASTM F877-11a, 'Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems'.
    - d. ASTM F1807-15, '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'.
    - e. ASTM F2023-15, 'Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water'.
    - f. ASTM F2389-15, 'Standard Specification for Pressure-rated Polypropylene (PP) Piping 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 14-2015, 'Plastic Piping System Components and Related Materials'.
    - b. NSF/ANSI 61-2015, '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.

## 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](http://www.aquathermpipe.com).
    - b. Acorn Controls, City of Industry, CA [www.acorneng.com](http://www.acorneng.com)
    - c. Cash Acme, Cullman, AL [www.cashacme.com](http://www.cashacme.com)
    - d. Chicago Faucets, Des Plaines, IL, [www.chicagofaucets.com](http://www.chicagofaucets.com).
    - e. Cla-Val Company, Costa Mesa, CA or Cla-Val Canada Ltd, Beamsville, ON [www.cla-val.com](http://www.cla-val.com).
    - f. Conbraco Industries Inc, Matthews, NC [www.conbraco.com](http://www.conbraco.com) or Conbraco (Honeywell Ltd), Scarborough, ON (416) 293-8111.
    - g. Hammond Valve, New Berlin, WI [www.hammondvalve.com](http://www.hammondvalve.com).
    - h. Handy & Harmon Products Div, Fairfield, CT [www.handyharmon.com](http://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](http://www.harrisproductsgroup.com).
    - j. Honeywell Inc, Minneapolis, MN [www.honeywell.com](http://www.honeywell.com).
    - k. Leonard Valve Co, Cranston, RI [www.leonardvalve.com](http://www.leonardvalve.com).
    - l. Milwaukee Valve Co, New Berlin, WI [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
    - m. Nibco Inc, Elkhart, IN [www.nibco.com](http://www.nibco.com).
    - n. Nupi Americas, Early Branch, SC [www.nupiamericas.com](http://www.nupiamericas.com).
    - o. Rehau, Leesburg, VA [www.rehau-na.com](http://www.rehau-na.com).
    - p. Sloan Valve Co, Franklin Park, IL [www.sloanvalve.com](http://www.sloanvalve.com).
    - q. Spence Engineering Co, Walden, NY [www.spenceengineering.com](http://www.spenceengineering.com).
    - r. Symmons Industries, Braintree, MA [www.symmons.com](http://www.symmons.com).
    - s. Uponor Inc, Apple Valley, MN [www.uponor-usa.com](http://www.uponor-usa.com).
    - t. Viega ProPress, Wichita, KS [www.viega-na.com](http://www.viega-na.com).
    - u. Watts Regulator Co, Andover, MA [www.wattsreg.com](http://www.wattsreg.com).
    - v. Wilkins (Zurn Wilkins), Paso Robles, CA [www.zurn.com](http://www.zurn.com).

w. Zurn PEX, Inc., Commerce, TX [www.zurnpex.com](http://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. 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** at **73 deg F**, **100 psi** at **180 deg F**, and **80 psi** at **200 deg F**.
    - 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).
3. Fittings:
  - a. 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. 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** SWP.
    - 1) Operate with flow in either direction, suitable for throttling and tight shut-off.
    - 2) Body: Bronze, **150 psig** wsp at **350 deg F** and **400 psig** wog.
    - 3) Seat: Bubble tight at **100 psig** under water.
5. Combination Pressure Reducing Valve / Strainer:
  - a. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
  - b. Meet ANSI/ASSE 1003 or CSA B356 requirements.
  - c. Built-in thermal expansion bypass check valve.
6. Mixing Valve For Lavatories:
  - a. Solid brass construction and CSA B125 certified.
  - b. Includes integral check valves and inlet screen. Features advanced paraffin-based actuation technology.
  - c. Flow of **5.7 GPM** with maximum **10 psi** pressure drop. Perform to minimum flow of **0.5 GPM** in accordance with ASSE 1070.
  - d. Set for **110 deg F** Service.
  - e. Match Construction Drawings for connection sizes.
  - f. Class One Quality Standard: Powers LFLM495. See Section 01 6200.
  - g. Acceptable Manufacturers: Acorn, Chicago Faucets, Leonard, Powers, Sloan, Symmons and Watts.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Locate cold water lines a minimum of **6 inches** 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 hydrostatic pressure for four (4) hours and show no leaks.
  - 2. Disconnect equipment not suitable for 125 psig 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.

### **3.4 ADDITIONAL MATERIALS**

- A. Provide one set of any proprietary tools required to perform maintenance on any systems/materials used.

**END OF SECTION**

## SECTION 22 1119

### DOMESTIC WATER PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Furnish and install miscellaneous potable water piping specialties as described in Contract Documents.

#### PART 2 - PRODUCTS

##### 2.1 ACCESSORIES

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. Ashcroft, Stratford, CT [www.ashcroftinc.com](http://www.ashcroftinc.com).
    - b. Chicago Faucet Co, Des Plaines, IL [www.chicagofaucets.com](http://www.chicagofaucets.com).
    - c. ConBraco Industries, Matthews, NC [www.conbraco.com](http://www.conbraco.com).
    - d. Febco, Denver, CO [www.repmasters.com](http://www.repmasters.com).
    - e. H O Trerice, Oak Park, MI [www.hotco.com](http://www.hotco.com).
    - f. IPS Corporation, Compton, CA [www.ipscorp.com](http://www.ipscorp.com).
    - g. Josam Co, Michigan City, IN [www.josam.com](http://www.josam.com).
    - h. Jay R. Smith Manufacturing Co, Montgomery, AL [www.jrsmith.com](http://www.jrsmith.com).
    - i. Mifab Manufacturing Inc, Chicago, IL [www.mifab.com](http://www.mifab.com).
    - j. Nibco Inc, Elkhart, IN [www.nibco.com](http://www.nibco.com).
    - k. Oatey, Cleveland, OH [www.oatey.com](http://www.oatey.com).
    - l. Precision Plumbing Products, Portland, OR [www.pppinc.net](http://www.pppinc.net).
    - m. Prier Products, Inc., Grandview, MD [www.prier.com](http://www.prier.com).
    - n. Proset Systems Inc., Lawrenceville, GA [www.prosetsystems.com](http://www.prosetsystems.com).
    - o. Sioux Chief Manufacturing Co, Peculiar, MO [www.siuoxchief.com](http://www.siuoxchief.com).
    - p. Sure Seal, Tacoma, WA [www.thesureseal.com](http://www.thesureseal.com).
    - q. Wade Div Tyler Pipe, Tyler, TX [www.wadedrains.com](http://www.wadedrains.com).
    - r. Watts Drainage, Spindale, NC [www.watts.com](http://www.watts.com) or Watts Industries, Burlington, ON, Canada [www.wattscda.com](http://www.wattscda.com).
    - s. Weiss Instruments, Inc., Holtsville, NY [www.weissinstruments.com](http://www.weissinstruments.com).
    - t. Woodford Manufacturing, Colorado Springs, CO [www.woodfordmfg.com](http://www.woodfordmfg.com).
    - u. Zurn Cast Metals, Erie, PA or Zurn Industries Limited, Mississauga, ON [www.zurn.com](http://www.zurn.com).
- B. Materials:
  - 1. Trap Guard Trap Seal:
    - a. Approved Products. See Section 01 6200 for definitions of Categories:
      - 1) Trap Guard by Proset:
        - a) Install per Manufacturer's recommendations.
      - 2) Sure Seal by Sure Seal:
        - a) Install per Manufacturer's recommendation.
    - b. Brass Gauge Cocks:
      - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        - a) 1092 by Ashcroft.
        - b) 865 by H O Trerice.
  - 2. Exterior Hydrants:
    - a. Provide with integral anti-siphon device. Key-operated.

- b. Non-freeze.
- 3. Shock Arrestors:
  - a. Provide shock arrestors at all quick close fittings including but not limited to flush valves, washing machine connections and drinking fountains.
  - b. Install with accessible isolation valve
  - c. Shock arrestors shall be premanufactured units tested and rated in accordance with PDI-WH-201 and ASSE-1010 sized per use.
  - d. Acceptable manufacturers: Zurn, Wade, Smith, Josam

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Gauges: Connect to pipe with **1/4 inch** connections utilizing gauge cocks.

**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 with outside utility lines **5 feet** out from building where applicable.
  - 2. Perform excavation and backfill required by work of this Section.

##### 1.2 ADMINISTRATIVE REQUIREMENTS

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

##### 1.3 REFERENCES

- A. Reference Standards:
  - a. ASTM D2321-11, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
  - b. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
  - c. ASTM D3034-08, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
  - d. ASTM F656-10, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
  - e. ASTM F891-10, 'Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core'.
- 2. International Code Council:
  - a. ICC IPC-2012, 'International Plumbing Code'.

#### PART 2 - PRODUCTS

##### 2.1 SYSTEMS

- A. Performance:
  - 1. Design Criteria:
    - a. Minimum size of waste piping installed under floor slab on grade shall be **2 inches**.
- B. 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.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
  - 1. Runs shall be as close as possible to those shown on Drawings.
  - 2. Excavate to required depth and grade to obtain fall required. Grade soil and waste lines within building perimeter **1/4 inch** fall in **one foot** in direction of flow.
  - 3. Bottom of trenches shall be hard. Tamp as required.
  - 4. Remove debris from trench before laying of pipe.
  - 5. Do not cut trenches near footings without consulting Architect.
- B. 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** 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**.
      - 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** or diameter of pipe plus **12 inches**, whichever is greater.
      - 2) Maximum: Outside diameter of pipe plus **24 inches**.
    - f. Do not use backhoe or power equipment to assemble pipe.
    - g. Initial backfill shall be **12 inches** 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** before wheel loading.
      - 2) **48 inches** before compaction.
- C. Install piping so cleanouts may be installed as follows:
  - 1. Where shown on Drawings and near bottom of each stack and riser.
  - 2. At every 135 degrees of accumulative change in direction for horizontal lines.
  - 3. Every **100 feet** of horizontal run.
  - 4. 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.
- D. 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.
- E. 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** minimum above roof and **12 inches** minimum from any vertical surface.
  - 2. Same size as vent pipe.
  - 3. In areas where minimum design temperature is below **0 deg F** 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** in diameter.
    - b. Vents shall terminate **10 inches** minimum above roof or higher if required by local codes.
- F. Furnish and install firestopping at penetrations of fire-rated structures as required.

- G. 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** 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.

#### PART 2 - PRODUCTS

##### 2.1 SYSTEMS

- A. Manufacturers:
1. Manufacturer Contact List:
    - a. H-M Company, Cincinnati, OH [www.draintroughs.com](http://www.draintroughs.com).
    - b. Josam Co, Michigan City, IN [www.josam.com](http://www.josam.com).
    - c. Jay R. Smith Manufacturing Co, Montgomery, AL [www.jrsmith.com](http://www.jrsmith.com).
    - d. Mifab Manufacturing Inc, Chicago, IL [www.mifab.com](http://www.mifab.com).
    - e. Proset Systems, Lawrenceville, GA [www.prosetsystems.com](http://www.prosetsystems.com).
    - f. Scherping Systems, Winstead, MN [www.scherpingsystems.com](http://www.scherpingsystems.com).
    - g. Sioux Chief Manufacturing Co, Peculiar, MO [www.siuoxchief.com](http://www.siuoxchief.com).
    - h. Sureseal Manufacturing, Tacoma WA [www.thesureseal.com](http://www.thesureseal.com).
      - 1) Contact Information:
        - a) All Areas except Idaho and Utah: Rick Ensley (253) 564-0624, [rick@thesureseal.com](mailto:rick@thesureseal.com).
        - b) Idaho and Utah Areas: Mark Evans, phone (801) 748-1222, [mark@franklinjames.com](mailto:mark@franklinjames.com).
    - i. Wade Div Tyler Pipe, Tyler, TX [www.wadedrains.com](http://www.wadedrains.com).
    - j. Watts Drainage, Spindale, NC [www.watts.com](http://www.watts.com) or Watts Industries, Burlington, ON, Canada [www.wattscda.com](http://www.wattscda.com).
    - k. Zurn Cast Metals, Erie, PA or Zurn Industries Limited, Mississauga, ON [www.zurn.com](http://www.zurn.com).

#### PART 3 - EXECUTION: Not Used

END OF SECTION

## SECTION 22 3423

### GAS DOMESTIC WATER HEATERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Furnish and install gas-fired instantaneous water heater as described in Contract Documents.

##### 1.2 REFERENCES

- A. Reference Standards:
  - 1. CSA Group / American National Standards Institute:
    - a. CSA ANSI Z21.22-99(R08)/CSA 4.4-M99(R08), 'Relief Valves for Hot Water Supply Systems'.

##### 1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
  - 1. Seismic Anchoring System:
    - a. Required for Seismic Design Category (SDC) C, D, E, or F or where authority having jurisdiction (AHJ) requires seismic protection use for water heater seismic anchoring systems.
    - b. Seismic Design Category (SDC) shall be determined by Project Structural Engineer.
  - 2. All products must be California certified/approved and labeled:
    - a. Straps/anchoring systems.
    - b. Fasteners.

##### 1.4 WARRANTY

- A. Manufacturer Warranty:

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT

- A. Materials:
  - 1. Condensing Type Water Heaters:
    - a. Stainless steel or 90/10 cupronickel heat exchanger, pressure tested and rated for 150 psi w.p. complete with thermostat, high limit control, gas pressure regulator, 100 percent safety shutoff and powered combustion air blower. AGA and CGA approved.
    - b. 94 percent thermal efficiency.
    - c. Temperature and pressure relief valve sized to match heat input and set to relieve at 120 psi.
    - d. Vacuum relief valve meeting requirements of CSA ANSI Z21.22.

## 2.2 ACCESSORIES

- A. Anchoring Components:
  - 1. One inch by 18 ga galvanized steel straps.
  - 2. No. 10 by 2-1/2 inch screws.
- B. Thermal Expansion Absorbers:
  - 1. Bladder type for use with potable water systems.
  - 2. Type One Acceptable Products:
    - a. Therm-X-Trol ST-12 by Amtrol Inc, West Warwick, RI [www.amtrol.com](http://www.amtrol.com).
    - b. Equal as approved by Architect before bidding. See Section 01 6200.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.
- B. Anchor water heaters to wall using two anchoring straps and specified screws.
  - 1. Anchors shall be installed with one on vertical upper 1/3 and one on lower 1/3 of water heater.
- C. Seismic Anchoring Systems shall be installed following Manufacturers requirements to California certifications or for minimum requirement, use Lag Bolts into studs.

### 3.2 ADJUSTING

- A. Set discharge water temperature at 120 deg F or as indicated on Contract Drawings.

**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.

#### PART 2 - PRODUCTS

##### 2.1 ASSEMBLIES

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. American Standard Brands, Piscataway, NJ [www.americanstandard-us.com](http://www.americanstandard-us.com) or American Standard Canada, Mississauga, ON [www.americanstandard.ca](http://www.americanstandard.ca).
    - b. AMTC - Advanced Modern Technologies Corp, Woodland Hills, CA [www.amtccorporation.com](http://www.amtccorporation.com).
    - c. Bemis Manufacturing Co, Sheboygan Falls, WI [www.bemismfg.com](http://www.bemismfg.com).
    - d. Beneke by Sanderson Plumbing Products, Columbus, MS [www.sppi.com](http://www.sppi.com).
    - e. BrassCraft Manufacturing Co, Novi, MI or BrassCraft Canada Ltd, St Thomas, ON [www.brasscraft.com](http://www.brasscraft.com).
    - f. Chicago Faucet Co, Des Plaines, IL [www.chicagofaucets.com](http://www.chicagofaucets.com).
    - g. Church Seat Co, Sheboygan Falls WI [www.churchseats.com](http://www.churchseats.com).
    - h. Delany Flush Valves, Charlottesville, VA [www.delanyproduct.com](http://www.delanyproduct.com).
    - i. Delta Faucet Co, Indianapolis, IN [www.deltafaucet.com](http://www.deltafaucet.com) or Delta Faucet Canada, London, ON (519) 659-3626.
    - j. Crane Plumbing, Evanston, IL [www.cranepumbing.com](http://www.cranepumbing.com) or Crane Canada Ltd, Plumbing Div, Montreal, PQ [www.cranepumbing.ca](http://www.cranepumbing.ca).
    - k. Dearborn Brass, Cleveland, OH [www.dearbornbrass.com](http://www.dearbornbrass.com).
    - l. Gerber Plumbing Fixtures LLC, Woodridge, IL [www.gerberonline.com](http://www.gerberonline.com).
    - m. Josam Co, Michigan City, IN [www.josam.com](http://www.josam.com).
    - n. Jay R. Smith Mfg. Co, Montgomery, AL [www.jrsmith.com](http://www.jrsmith.com).
    - o. Kohler Co Plumbing Div, Kohler, WI [www.us.kohler.com](http://www.us.kohler.com).
    - p. McGuire Manufacturing Co, Cheshire, CT [www.mcguiremfg.com](http://www.mcguiremfg.com).
    - q. Mifab Manufacturing Inc, Amherst, NY [www.mifab.com](http://www.mifab.com).
    - r. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON [www.moen.com](http://www.moen.com).
    - s. Olsonite Corp, Newnan, GA [www.olsonite.net](http://www.olsonite.net) or Olsonite Co Ltd, Tilbury, ON (519) 682-1240.
    - t. Sloan Valve Co, Franklin Park, IL [www.sloanvalve.com](http://www.sloanvalve.com).
    - u. South Fork Manufacturing, Coalville, UT (801) 953-3001 [www.dirt-grabber.com](http://www.dirt-grabber.com).
    - v. Toto U.S.A., Inc., Morrow, GA [www.totousa.com](http://www.totousa.com).
    - w. Wade Div Tyler Pipe, Tyler, TX [www.wadedrains.com](http://www.wadedrains.com).
    - x. Zurn Commercial Brass, Sanford, NC [www.zurn.com](http://www.zurn.com) or Zurn Industries Ltd, Mississauga, ON (905) 795-8844.
    - y. Zurn Cast Metal, Erie, PA [www.zurn.com](http://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. All materials must be low lead compliant.

## **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.
  - 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. 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 branch supply line.
- F. Make fixture floor connections with approved brand of cast iron floor flange, soldered or caulked securely to waste pipe. Make joints between fixtures and floor flanges tight with approved fixture setting compound or gaskets. Caulk between fixtures and floor with sealant. Point edges.

### **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.

##### 1.2 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.

##### 1.3 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](http://www.americanstandard-us.com) or American Standard Canada, Mississauga, ON [www.americanstandard.ca](http://www.americanstandard.ca).
    - b. BrassCraft Manufacturing Co, Novi, MI or BrassCraft Canada Ltd, St Thomas, ON [www.brasscraft.com](http://www.brasscraft.com).
    - c. Brocar Products Inc, Cincinnati, OH [www.brocar.com](http://www.brocar.com).
    - d. CECO, Huntington Park, CA [www.cecosinks.com](http://www.cecosinks.com).
    - e. Chicago Faucet Co, Des Plaines, IL [www.chicagofaucets.com](http://www.chicagofaucets.com).
    - f. Dearborn Brass, Tyler, TX [www.dearbornbrass.com](http://www.dearbornbrass.com).
    - g. Delta Faucet Co, Indianapolis, IN [www.deltafaucet.com](http://www.deltafaucet.com) or Delta Faucet Canada, London, ON (519) 659-3626.
    - h. EBC / Just Manufacturing Co, Franklin Park, IL [www.justmfg.com](http://www.justmfg.com).
    - i. Elkay Manufacturing Co, Oak Brook, IL [www.elkay.com](http://www.elkay.com).
    - j. Fiat Products, Evanston, IL [www.cranepumbing.com](http://www.cranepumbing.com) or Fiat Products Ltd, Winnipeg, MB [www.fiat.ca](http://www.fiat.ca).
    - k. Gerber Plumbing Fixtures LLC, Woodridge, IL [www.gerberonline.com](http://www.gerberonline.com).
    - l. Josam Co, Michigan City, IN [www.josam.com](http://www.josam.com).
    - m. Jay R. Smith Manufacturing Co, Montgomery, AL [www.jrsmith.com](http://www.jrsmith.com).
    - n. Just Manufacturing Co, Franklin Park, IL [www.justsinks.com](http://www.justsinks.com).
    - o. Keeney Manufacturing Co, Newington, CT [www.keeneymfg.com](http://www.keeneymfg.com).
    - p. Kindred USA, Midland, ON [www.kindred-sinkware.com](http://www.kindred-sinkware.com).
    - q. Kohler Co Plumbing Div, Kohler, WI [www.us.kohler.com](http://www.us.kohler.com).
    - r. McGuire Manufacturing Co, Cheshire, CT [www.mcguiremfg.com](http://www.mcguiremfg.com).
    - s. Mifab Manufacturing Inc, Amherst, NY [www.mifab.com](http://www.mifab.com).

- t. Moen Incorporated, North Olmsted, OH, or Moen Canada, Oakville, ON [www.moen.com](http://www.moen.com).
  - u. Omni Flow Controls, Harbor City, CA [www.chronomite.com](http://www.chronomite.com) or [www.omniflowcontrols.com](http://www.omniflowcontrols.com).
  - v. Sloan Valve Co, Franklin Park, IL [www.sloanvalve.com](http://www.sloanvalve.com).
  - w. Speakman Company, New Castle, DE [www.speakmancompany.com](http://www.speakmancompany.com).
  - x. Stern-Williams, Shawnee Mission, KS [www.sternwilliams.com](http://www.sternwilliams.com).
  - y. Symmons, Braintree, MA [www.symmons.com](http://www.symmons.com).
  - z. T & S Brass & Bronze Works Inc, Travelers Rest, SC [www.tsbrass.com](http://www.tsbrass.com).
  - aa. TrueBro Inc, Collierville, TN [www.truebro.com](http://www.truebro.com).
  - bb. Wade Div Tyler Pipe, Tyler, TX [www.wadedrains.com](http://www.wadedrains.com).
  - cc. Watts Drainage, Spindale, NC [www.wattsdrainage.com](http://www.wattsdrainage.com) or Watts Industries, Burlington, ON, Canada [www.wattscda.com](http://www.wattscda.com).
  - dd. Zurn Commercial Brass, Sanford, NC [www.zurn.com](http://www.zurn.com) or Zurn Industries Ltd, Mississauga, ON (905) 795-8844.
  - ee. Zurn Cast Metal, Erie, PA [www.zurn.com](http://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.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.
- B. Seal wall-mounted fixtures around edges to wall and counter top fixtures to countertop with sealant specified in Section 07 9213.
- C. Unless otherwise noted, provide each individual fixture supply with chrome-plated stop valve with hand wheel.
- D. Install fixtures with accessible stop or control valve in each hot and cold water branch supply line.
- E. Self-Supporting Lavatories: Install using carriers. Support carrier free of finished wall.
- F. Install Safety Covers on all under sink / lavatories with exposed water supply pipes and traps.
- G. Install Handicap Accessible Lavatories as per ADA height mounting requirements.

### **3.2 CLEANING**

- A. Polish chrome finish at completion of Project.

**END OF SECTION**

## **DIVISION 23: MECHANICAL**

23 0501	COMMON HVAC REQUIREMENTS
23 0529	HANGER AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0548	VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT
23 0713	DUCT INSULATION
23 0719	HVAC PIPING INSULATION
23 1123	FACILITY NATURAL GAS PIPING
23 2300	WIRING DEVICES
23 2600	REFRIGERANT PIPING
23 3114	LOW PRESSURE METAL DUCTS
23 3346	FLEXIBLE DUCTS
23 3400	HVAC FANS
23 3713	DIFFUSERS, REGISTERS AND GRILLES
23 3713.01	SLOT DIFFUSERS
23 7433	DEDICATED OUTSIDE AIR SYSTEMS
23 8129	VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

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.
  - 6. Furnish and install sound, vibration, and seismic control elements.
- B. Products Furnished But Not Installed Under This Section:
  - 1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.

##### 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. Informational Submittals:
  - 1. Qualification Statement:
    - a. HVAC Firm:
      - 1) Provide Qualification documentation for manufacturer selected.
- 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 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. 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.
- 2. 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** 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.
- C. Sleeves:
  1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or **14 ga** 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. Alternate manufacturer are acceptable. Where alternates are listed only those manufacturer's listed are acceptable unless approved before bidding. Any changes due to alternate manufacturers, even those where listed, are the responsibility of the contractor.
2. 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.
3. 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.
4. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
5. 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. 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, 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.

C. 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) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
      - a) Make connections of dissimilar metals with di-electric unions.
      - b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
    - 2) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.
    - 3) Install liquid 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.
    - 4) Install piping to insure noiseless circulation.
    - 5) 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.
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** 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.
- D. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.
- E. 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. 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 and Refrigeration: Two (2) hours.
      - 2) Temperature Control: 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.

**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.

##### 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. Approved Manufacturers.
    - a. Anvil International, Portsmouth, NH [www.anvilintl.com](http://www.anvilintl.com).
    - b. Cooper B-Line, Highland, IL [www.cooperblineline.com](http://www.cooperblineline.com).
    - c. Erico International, Solon, OH [www.erico.com](http://www.erico.com).
    - d. Hilti Inc, Tulsa, OK [www.hilti.com](http://www.hilti.com).
    - e. Minerallac, Hampshire, IL [www.minerallac.com](http://www.minerallac.com).
    - f. Thomas & Betts, Memphis, TN [www.superstrut.com](http://www.superstrut.com).
    - g. Unistrut, Wayne, MI [www.unistrut.com](http://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

- 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		
2	3/8 Inch	Two	0	0	0	0		
2	1/2 Inch	Three	Three	Two	0	0		
2	5/8 Inch	Six	Four	Three	Two	0		
2	5/8 Inch	Nine	Seven	Five	Three	Two		
2	5/8 Inch	Twelve	Nine	Seven	Five	Three		

- 1) Size trapeze angles so bending stress is less than **10,000 psi**.

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. 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) Quality Standard: Anvil Figure 261.
    - 2) Quality Standards:
      - a) Standard Inserts: Anvil Figure 282.
    - 3) Quality Standards:
      - a) Continuous Inserts: Unistrut P-3200 series.
      - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
      - c) Equal as approved by Architect before installation. See Section 01 6200.Steel
  - e. Deck Bracket:
    - 1) **6 inch** length minimum.
    - 2) Quality Standard: Unistrut P1000 with clamp nut.
    - 3) Acceptable Manufacturers: Hilti, Thomas & Betts.
    - 4) Equal as approved by Architect before installation. See Section 01 6200.
  - f. Furnace / Fan Coil Support Channel:
    - 1) Quality Standard: Unistrut P1000.
    - 2) Acceptable Manufacturers: Hilti, Thomas & Betts.
    - 3) Equal as approved by Architect before installation. See Section 01 6200.
  - g. Swivel Attachment:
    - 1) Quality Standard: Unistrut EM3127.
    - 2) Acceptable Manufacturers: Hilti, Thomas & Betts.
    - 3) Equal as approved by Architect before installation. See Section 01 6200.

## EXECUTION

### 2.2 INSTALLATION

A. Piping:

1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
  - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
  - b. Supports For Horizontal Piping:
    - 1) Support metal piping at **96 inches** on center maximum for pipe **1-1/4 inches** or larger and **72 inches** on center maximum for pipe **1-1/8 inch** or less.
    - 2) Support thermoplastic pipe at **48 inches** 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 of straight run.
  - 2) Provide 12 inch offset below roof line in each vent line penetrating roof.

**END OF SECTION**

## SECTION 23 0548

### VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

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

##### 1.2 REFERENCES

- A. Association Publications:
  - 1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
    - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
  - 2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
    - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
    - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
- B. Definitions:
  - 1. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.
- C. Reference Standards:
  - 1. American National Standards Institute / Sheet Metal And Air Conditioning Contractors' National Association:
    - a. ANSI/SMACNA 001-2008, 'Seismic Restraint Manual: Guidelines For Mechanical Systems' (3rd Edition).
  - 2. American Society of Civil Engineers / Structural Engineering Institute:
    - a. ASCE/SEI 7-10, 'Minimum Design Loads for Buildings and Other Structures'.
      - 1) Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
  - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
    - a. 2011 ASHRAE Handbook - HVAC Applications.
      - 1) Chapter 48, 'Noise and Vibration Control'.
      - 2) Chapter 55, 'Seismic- and Wind-Resistant Design'.
  - 4. ASTM International:
    - a. ASTM A615/A615M-12, 'Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement'.

##### 1.3 SUBMITTALS

- A. Action Submittals:
  - 1. Product Data:
    - a. Restraint system and anchorage method to be used for each piece of equipment.
    - b. Seismic restraints and calculations for all flexible mounted equipment.
    - c. Vibration isolators and flexible couplings.
    - d. Clearly outlined procedures for installing and adjusting isolators, seismic bracing anchors, and snubbers.
  - 2. Shop Drawings:
    - a. Show size, hanger length, and location of seismic restraints for piping and ductwork.

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

## 1.4 QUALITY ASSURANCE

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

## PART 2 - PRODUCTS

### 2.1 ASSEMBLIES

- A. Manufacturers:
  - 1. Type One Acceptable Manufacturers:
    - a. Amber / Booth Company, Houston, TX [www.amberbooth.com](http://www.amberbooth.com).
    - b. Mason Industries Inc, Hauppauge, NY [www.mason-ind.com](http://www.mason-ind.com).
    - c. Vibration Mountings and Control Inc, Bloomington, NJ (201) 838-1780.
    - d. Equal as approved by Architect before bidding. See Section 01 6200.
- B. Performance:
  - 1. Design Criteria:
    - a. Isolation And Seismic Equipment:
      - 1) Piping: Restrain piping in accordance with ANSI/SMACNA 001 Seismic Restraint Manual, Chapter 4, Figures 4.11 to 4.19.
      - 2) Equipment with Fixed Anchor or Support:
        - a) Restraint designed according to ASCE/SEI 7-10, Chapter 13, 'Seismic Design Requirements For Nonstructural Components'.
        - b) Horizontal force factor for elements of structures:
          - (1) In addition, vertical force restraint requirement shall be computed at 1/2 value of horizontal forces.
          - (2) Restrain equipment not anchored directly to floors by cable system designed and furnished by Restraint Manufacturer.
      - 3) Ductwork: Restrain ductwork in accordance with ANSI/SMACNA 001 Seismic Restraint Manual, Chapter 4, Figures 4.2 to 4.10 as appropriate.
    - b. Vibration Isolation Requirements:
      - 1) Isolate equipment from structure by means of resilient vibration and noise isolators.
      - 2) Unless otherwise noted, isolate HVAC equipment one horsepower and over from structure by means of resilient vibration and noise isolators in accordance with

ASHRAE 'Handbook - HVAC Applications', Chapter 48, Table 1, 'Design Guidelines for HVAC-Related Background Sound in Rooms'.

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

C. Finishes:

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

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Isolation Equipment:

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

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

**END OF SECTION**

## SECTION 23 0713

### DUCT INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Furnish and install thermal wrap duct insulation as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 23 3114: 'Low-Pressure Metal Ducts'.
  - 2. Section 23 3300: 'Acoustic Duct Accessories' for duct liner.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

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

##### 2.2 MATERIALS

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

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

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

- 2) 1-1/2 inch 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.
  - a. Do not compress insulation except in areas of structural interference. Minimum thickness at corners shall be one inch thick.
  - b. Remove insulation from lap before stapling.
  - c. Staple seams at approximately 16 inches on center with outward clenching staples.
  - d. Seal seams with foil vapor barrier tape or vapor barrier mastic. Seal penetrations of facing to provide vapor tight system.

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

#### END OF SECTION

## SECTION 23 0719

### HVAC PIPING INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.
  - 2. Furnish and install insulation for hot water heating and return piping system as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 23 0501: 'General HVAC Requirements'.

##### 1.2 DELIVERY, STORAGE, AND HANDLING

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

#### PART 2 - PRODUCTS

##### 2.1 ASSEMBLIES

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

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

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

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

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

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before application of insulating materials, brush clean surfaces to be insulated and make free from rust, scale, grease, dirt, moisture, and any other deleterious materials.
- B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the work.

### **3.2 INSTALLATION**

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

### **3.3 FIELD QUALITY CONTROL**

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

### **3.4 CLEANING**

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

### **3.5 PROTECTION**

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

**END OF SECTION**

## SECTION 23 1123

### FACILITY NATURAL-GAS PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Includes But Not Limited To:
  - 1. Perform excavation and backfill required for work of this Section.
  - 2. Furnish and install gas piping and fittings within building and from building to meter including connection to meter as described in Contract Documents.
- B. Related Requirements:
  - 1. Sections Under 09 9000 Heading: Painting of exterior piping.
  - 2. Section 23 0501: 'Common HVAC Requirements'.

##### 1.2 REFERENCES

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

##### 1.3 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Pipe Installers:
    - a. Polyethylene pipe installers shall be properly trained and certified in procedure for joining polyethylene pipe.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

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

#### PART 2 - PRODUCTS

##### 2.1 SYSTEM

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. BrassCraft, Novi, MI [www.brasscraft.com](http://www.brasscraft.com).
    - b. Cimberio Valve Co Inc, Malvern, PA [www.cimberio.com](http://www.cimberio.com).
    - c. ConBraCo Industries, Inc, Matthews, NC [www.conbraco.com](http://www.conbraco.com) or ConBraCo / Honeywell Ltd, Scarborough, ON (416) 293-8111.
    - d. Dormont Manufacturing Company, Export, PA [www.dormont.com](http://www.dormont.com).
    - e. Jenkins-NH-Canada, Brantford, ON [www.jenkins-nh-canada.com](http://www.jenkins-nh-canada.com).

- f. Jomar International, Madison Heights, MI [www.jomar.com](http://www.jomar.com).
  - g. California Valves (formally KOSO) by Pacific Seismic Products Inc, Lancaster, CA, Distributed by Strand Earthquake Consultants [www.strandearthquake.net](http://www.strandearthquake.net).
  - h. Watts Regulator Co, North Andover, MA [www.wattsreg.com](http://www.wattsreg.com) or Watts Industries (Canada) Inc, Burlington, ON (888) 208-8927.
- B. Materials:
- 1. Above-Ground Pipe And Fittings:
    - a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of A53/A53M.
    - b. Welded forged steel fittings meeting requirements of ASTM A234/A234M or standard weight malleable iron screwed.
  - 2. Valves:
    - a. **125 psi** bronze body ball valve, UL listed.
    - b. Approved Products:
      - 1) CIM 102.1 by Cimbrio Valve.
      - 2) Apollo Series 80-100 by ConBraCo.
      - 3) 'Red Cap' R602 by Jenkins NH Canada.
      - 4) Model T-204 by Jomar International.
      - 5) Model B-6000-UL by Watts Regulator.
  - 3. Cocks:
    - a. Gauge Cocks: Conbraco Series 50-56 bronze gauge cock.
  - 4. Flexible Connector:
    - a. Type 304 stainless steel corrugated tube coated for corrosion protection.
    - b. Approved Products:
      - 1) Dormont Supr-Safe.
      - 2) BrassCraft Procoat.
      - 3) Size to be determined by total **cu ft** per hour gas flow requirement of building and following conditions: **0.1 inch** water column maximum allowable pressure-drop through valve with available pressure of **4 oz**.
      - 4) Approved Product:
        - a) California Seismic Gas Shutoff Valve (formally KOSO):
          - (1) Horizontal installation: Model 314F or 315F.
          - (2) Vertical installation with bottom inlet: Model VB314F or VB315F.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Steel pipe installed through air plenums, in walls, and pipes **2-1/2 inches** and larger shall have welded fittings and joints. Other steel pipe may have screwed or welded fittings.
- B. Lay underground pipe in accordance with Manufacturer's recommendations and local gas utility company regulations and specifications.
  - 1. Provide **24 inch** minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of polyethylene line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
  - 2. Place tracer wire along side of polyethylene pipe from meter to point where pipe rises inside building.
  - 3. Place **4 inches** of sand around gas line buried underground.
  - 4. Do not install gas piping under building floor slabs-on-grade.
- C. On lines serving gas-fired equipment, install gas cocks adjacent to equipment outside of equipment cabinet and easily accessible.
- D. Install **6 inch** long minimum dirt leg, with pipe cap, on vertical gas drop serving each gas-fired equipment unit.

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

### **3.2 FIELD QUALITY CONTROL**

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

**END OF SECTION**

## SECTION 23 2300

### REFRIGERANT PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

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

##### 1.2 REFERENCES

- A. Association Publications:
  - 1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
    - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
  - 2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
    - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
    - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
- B. Definitions:
  - 1. 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 Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
    - b. ANSI/ASHRAE Standard 34-2010, '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-08, 'Standard Specification for Carbon Structural Steel'.
    - b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.
  - 5. National Fire Protection Association / American National Standards Institute:
    - a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
  - 6. Underwriters Laboratories:
    - a. UL 2182, 'Refrigerants' (2nd Edition).

##### 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](http://www.noventcaps.com).
    - b. Cush-A-Clamp by ZSI Manufacturing, Canton, MI [www.cushaclamp.com](http://www.cushaclamp.com).
    - c. Elkhart Products Corp, Elkhart, IN [www.elkhartproducts.com](http://www.elkhartproducts.com).
    - d. Emerson Climate Technologies, St Louis, MO [www.emersonflowcontrols.com](http://www.emersonflowcontrols.com).
    - e. Handy & Harman Products Division, Fairfield, CT [www.handy-1.com](http://www.handy-1.com).
    - f. Harris Products Group, Cincinnati, OH [www.harrisproductsgroup.com](http://www.harrisproductsgroup.com).
    - g. Henry Valve Co, Melrose Park, IL [www.henrytech.com](http://www.henrytech.com).
    - h. Hilti Inc, Tulsa, OK [www.hilti.com](http://www.hilti.com).
    - i. Hydra-Zorb Co, Auburn Hills, MI [www.hydra-zorb.com](http://www.hydra-zorb.com).
    - j. JB Industries, Aurora, IL [www.jbind.com](http://www.jbind.com).
    - k. Mueller Steam Specialty, St Pauls, NC [www.muellersteam.com](http://www.muellersteam.com).
    - l. Nibco Inc, Elkhart, IN [www.nibco.com](http://www.nibco.com).
    - m. Packless Industries, Waco, TX [www.packless.com](http://www.packless.com).
    - n. Parker Corp, Cleveland, OH [www.parker.com](http://www.parker.com).
    - o. Sporlan Valve Co, Washington, MO [www.sporlan.com](http://www.sporlan.com).
    - p. Sherwood Valves, Washington, PA [www.sherwoodvalve.com](http://www.sherwoodvalve.com).
    - q. Thomas & Betts, Memphis, TN [www.superstrut.com](http://www.superstrut.com).
    - r. Unistrut, Div of Atkore International, Inc., Harvey, IL [www.unistrut.com](http://www.unistrut.com).
    - s. Universal Metal Hose, Chicago, IL [www.universalmetalhose.com](http://www.universalmetalhose.com).
    - t. Vibration Mountings & Controls, Bloomington, NJ [www.vmc-kdc.com](http://www.vmc-kdc.com).
    - u. Virginia KMP Corp, Dallas, TX [www.virginiakmp.com](http://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. Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      - 1) Mueller Streamline.
      - 2) Nibco Inc.
      - 3) Elkhart.
  - 3. Suction Line Traps:
    - a. Manufactured standard one-piece traps.
    - b. Approved Manufacturers:

- 1) Mueller Streamline.
  - 2) Nibco Inc.
  - 3) Elkhart.
4. Tee Access:
  - a. Brass:
    - 1) Approved Manufacturers:
      - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
5. 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.
6. Valves:
  - a. Expansion Valves:
    - 1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
    - 2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
    - 3) Approved Manufacturers:
      - a) Emerson Climate Technologies.
      - b) Henry.
      - c) Mueller.
      - d) Parker.
      - e) Sporlan.
  - b. Manual Refrigerant Shut-Off Valves:
    - 1) Ball valves designed for refrigeration service and full line size.
    - 2) Valve shall have cap seals.
    - 3) Valves with hand wheels are not acceptable.
    - 4) Provide service valve on each liquid and suction line at compressor.
    - 5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
    - 6) Approved Manufacturers:
      - a) Henry.
      - b) Mueller.
      - c) Sherwood.
      - d) Virginia.
7. Filter-Drier:
  - a. On lines **3/4 inch** outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
  - b. On lines smaller than **3/4 inch** outside diameter, filter-drier shall be sealed type with brazed end connections.
  - c. Size shall be full line size.
  - d. Approved Manufacturers.
    - 1) Emerson Climate Technologies.
    - 2) Mueller.
    - 3) Parker.
    - 4) Sporlan.
    - 5) Virginia.
8. 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. Approved Product:
    - 1) HMI by Emerson Climate Technologies.
- 9. Flexible Connectors:
  - a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
  - b. Approved Products:
    - 1) Vibration Absorber Model VAF by Packless Industries.
    - 2) Vibration Absorbers by Virginia KMP Corp.
    - 3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
    - 4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
- 10. Refrigerant Piping Supports:
  - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
  - b. Securing Channels:
    - 1) At Free-Standing Pipe Support:
      - a) Class One Quality Standard: P-1000 channels by Unistrut.
      - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
      - c) Equal as approved by Architect before installation. See Section 01 6200.
    - 2) At Wall Support:
      - a) Class One Quality Standard: P-3300 channels by Unistrut.
      - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
      - c) Equal as approved by Architect before installation. See Section 01 6200.
    - 3) At Suspended Support:
      - a) Class One Quality Standard: P-1001 channels by Unistrut.
      - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
      - c) Equal as approved by Architect before installation. See Section 01 6200.
    - 4) Angle Fittings:
      - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
      - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
      - c) Equal as approved by Architect before installation. See Section 01 6200.
  - c. Pipe Clamps:
    - 1) Type Two Acceptable Manufacturers:
      - a) Hydra-Zorb.
      - b) ZSI Cush-A-Clamp.
      - c) Hilti Cush-A-Clamp.
      - d) Equal as approved by Architect before installation. See Section 01 6200.
  - d. Protective Cover: 18 ga steel, hot-dipped galvanized.
- 11. Locking Refrigerant Cap:
  - a. Provide and install on charging valves:
    - 1) 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. Locate traps at vertical rises against flow in suction lines.
- B. Connections:
  - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
  - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.

3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.
- C. Specialties:
1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
  2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
  3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
  4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.
- D. Refrigerant Supports:
1. Support Spacing:
    - a. Piping **1-1/4 inch** And Larger: **8 feet** on center maximum.
    - b. Piping **1-1/8 inch** And Smaller: **6 feet** on center maximum.
    - c. Support each elbow.
  2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
  3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

### 3.2 FIELD QUALITY CONTROL

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

##### 1.2 REFERENCES

- A. Reference Standards:
  - 1. ASTM International:
    - a. ASTM D1785-12, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.

#### PART 2 - PRODUCTS

##### 2.1 SYSTEMS

- A. Materials:
  - 1. Condensate Drains:
    - a. Type M copper meeting requirements of ASTM B88 or Schedule 40 PVC for condensate drains from air handling units, fan coil units, and furnace coils.
- B. Condensate Pump:
  - a. Rated at 225 gph at 15 feet total head.
  - b. As supplied by air handler manufacturer. Only where required for drop.

#### PART 3 - SCOPE

##### 3.1 SCOPE

- A. Install condensate drain lines from all units and auxiliary drain pans to drain to grade. Size at full size of connection or as recommended by manufacturer.

#### PART 4 - EXECUTION

##### 4.1 INSTALLATION

- A. Condensate Drains:
  - 1. Support piping and protect from damage.

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.

##### 1.2 REFERENCES

- A. Reference Standards:
  - 1. ASTM International:
    - a. ASTM A653/A653M-11, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
  - 2. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
    - a. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (Third Edition).

#### 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. Approved Products. See Section 01 6200 for definitions of Categories:
      - 1) Duct Butter or Butter Tak by Cain Manufacturing Co Inc, Pelham, AL [www.cainmfg.com](http://www.cainmfg.com).
      - 2) DP 1010 by Design Polymerics, Fountain Valley, CA [www.designpoly.com](http://www.designpoly.com).
      - 3) SAS by Duro Dyne, Bay Shore, NY or Duro Dyne Canada, Lachine, QB [www.durodyne.com](http://www.durodyne.com).
      - 4) Iron Grip 601 by Hardcast Inc, Wylie, TX [www.hardcast.com](http://www.hardcast.com).
      - 5) MTS100 or MTS 200 by Hercules Mighty Tough, Denver CO, [www.herculesindustries.com](http://www.herculesindustries.com).
      - 6) 15-325 by Miracle / Kingco, Div ITW TACC, Rockland, MA [www.taccint.com](http://www.taccint.com).
      - 7) 44-39 by Mon-Eco Industries Inc, East Brunswick, NJ [www.mon-ecoindustries.com](http://www.mon-ecoindustries.com).
      - 8) Airseal Zero by Polymer Adhesive Sealant Systems Inc, Weatherford, TX [www.polymeradhesives.com](http://www.polymeradhesives.com).
      - 9) Airseal #22 Water Base Duct Sealer by Polymer Adhesive Sealant Systems Inc, Weatherford, TX [www.polymeradhesives.com](http://www.polymeradhesives.com).
  - 3. Duct Sealer For Exterior Ducts:
    - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - 1) Hardcast DT Tape and RTA-50 liquid adhesive by Hardcast Inc, Wylie, TX [www.hardcast.com](http://www.hardcast.com).
- B. Fabrication:
  - 1. General:

- a. Straight and smooth on inside with joints neatly finished.
- b. Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck. Drops shall be same gauge as branch duct. Seal joints air tight.
- 2. Standard Ducts:
  - a. General:
    - 1) Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
  - b. Rectangular Duct:
    - 1) Duct panels through 48 inch dimension having acoustic duct liner need not be cross-broken or beaded.
      - a) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        - (1) Ductmate Industries Inc, Charleroi, PA [www.ductmate.com](http://www.ductmate.com) or Ductmate Canada Ltd, Burlington, ON (905) 332-7678.
        - (2) Ward Industries Inc, Bensonville, IL [www.wardind.com](http://www.wardind.com).
        - (3) Elgen Manufacturing Company, Inc., East Rutherford, NJ [www.elgenmfg.com](http://www.elgenmfg.com).
  - c. Round Duct:
    - 1) Spiral Seam: 28 ga minimum for ducts up to and including 14 inches in diameter.
    - 2) Longitudinal Seam:
      - a) 28 ga minimum for ducts up to and including 8 inches in diameter.
      - b) 26 ga minimum for ducts over 8 inches and up to 14 inches in diameter.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Interface With Other Work: Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures specified in Section 01 4546, at no additional cost to Owner.
- B. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.
- C. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.
- D. Ducts shall not bear on top of structural members.
- E. Paint ductwork visible through registers, grilles, and diffusers flat black.
- F. Properly flash where ducts protrude above roof.
- G. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

### END OF SECTION

## SECTION 23 3346

### FLEXIBLE DUCTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

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

##### 1.2 REFERENCES

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

#### PART 2 - PRODUCTS

##### 2.1 SYSTEM

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. Anco Products Inc, Elkhart, IN [www.ancoproductsinc.com](http://www.ancoproductsinc.com).
    - b. Thermaflex by Flexible Technologies, Abbeville, SC or Mississauga, ON [www.thermaflex.net](http://www.thermaflex.net).
    - c. Flexmaster USA Inc, Houston, TX [www.flexmasterusa.com](http://www.flexmasterusa.com) or Flexmaster Canada Ltd, Richmond Hill, ON (905) 731-9411.
- 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, 3/4 lb per cu ft 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. Approved Products. See Section 01 6200 for definitions of Categories:
      - 1) ANCO-FLEX 4625 by Anco Products.
      - 2) M-KC by Thermaflex by Flexible Technologies.
      - 3) Type 4m Insulated by Flexmaster.
  - 2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

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

**END OF SECTION**

## SECTION 23 3400

### HVAC FANS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

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

##### 1.2 QUALITY ASSURANCE

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

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturer Contact List:
  - 1. Acme Engineering & Manufacturing Corp, Muskogee, OK [www.acmefan.com](http://www.acmefan.com).
  - 2. Breidert Air Products, Jacksonville, FL [www.breidert.com](http://www.breidert.com).
  - 3. Carnes Co, Verona, MI [www.carnes.com](http://www.carnes.com).
  - 4. Greenheck Corp, Schofield, WI [www.greenheck.com](http://www.greenheck.com).
  - 5. Loren Cook Co, Springfield, MO [www.lorencook.com](http://www.lorencook.com).
  - 6. PennBarry, Richardson, TX (215) 464-8900 [www.pennbarry.com](http://www.pennbarry.com).

##### 2.2 MANUFACTURED UNITS

- A. Ceiling Mounted Exhaust Fans:
  - 1. Acoustically insulated housings. Sound level rating of 4.6 sones maximum for fan RPM and CFM listed on 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. Class One Quality Standards:
    - a. Greenheck SP.
    - b. PennBarry Zephyr.
  - 8. Approved Manufacturers. See Section 01 6200.
    - a. Acme, Breidert, Broan, Carnes, Cook-Gemini, Greenheck, PennBarry.

## **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](http://www.carnes.com).
  - 2. J & J Register, Grand Rapids, MI [www.jandjreg.com](http://www.jandjreg.com).
  - 3. Krueger Air System Components, Richardson, TX [www.krueger-hvac.com](http://www.krueger-hvac.com).
  - 4. Metal\*Aire by Metal Industries Inc, Clearwater, FL [www.metalaire.com](http://www.metalaire.com).
  - 5. Nailor Industries Inc, Houston, TX or Weston, ON [www.nailor.com](http://www.nailor.com).
  - 6. Price Industries Inc, Suwanee, GA [www.price-hvac.com](http://www.price-hvac.com) or E H Price Ltd, Winnipeg, MB (204) 669-4220.
  - 7. Titus, Richardson, TX [www.titus-hvac.com](http://www.titus-hvac.com).
  - 8. Tuttle & Bailey, Richardson, TX [www.tuttleandbailey.com](http://www.tuttleandbailey.com).

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

- A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side.

END OF SECTION

# T-Bar Diffusers

## Division 23 – Heating, Ventilating, and Air Conditioning

### Section 23 37 13 – Diffusers, Registers, and Grilles

Note: Specifications are for the price industries slot diffusers designed. Alternate manufacturers will be evaluated and accepted or rejected based on their similarity with these specifications. Alternates may be submitted before or after bid however if after bid it is at the contractors risk of alternate being rejected.

#### PART 1 – GENERAL

##### 1.01 Section includes:

- A. T-Bar Diffusers

##### 1.02 Related Requirements

- A. Section 01 30 00 – Administrative Requirements
- B. Section 01 40 00 – Quality Requirements
- C. Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- D. Section 01 78 00 – Closeout Submittals
- E. Section 01 79 00 – Demonstration and Training

##### 1.03 Reference Standards

- A. All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.
- B. ASHRAE 70 – Standard Method of Testing the Performance of Air Outlets and Air Inlets
- C. ASTM D610 – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
- D. ASTM D714 – Standard Test Method for Evaluating Degree of Blistering of Paints
- E. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- F. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- G. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

##### 1.04 Submittals

- A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, and NC designation.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication.
- D. Project Record Documents: Record actual locations of units and control components.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions (if applicable), and maintenance and repair data.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

##### 1.06 Quality Assurance

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

##### 1.07 Warranty

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 12 month manufacturer warranty from date of shipment of diffusers.

## PART 2 – PRODUCTS

### 2.01 Manufacturer

- A. Basis of Design: Price Industries, Inc.
  - 1. T-Bar Supply Diffusers: Model TBD
  - 2. Fire-rated T-bar Supply Diffusers: TBD-FR
  - 3. T-bar Return Diffusers: Model TBR
  - 4. Fire-rated T-bar Return Diffusers: Model TBR-FR

### 2.02 T-bar Supply Diffusers

- A. Description:
  - 1. Furnish and install Price model TBD T-bar supply diffusers in sizes and capacities as shown by the plans and air distribution schedule. Provide drawings accompanied by an itemized list indicating the unit locations and appropriate product submittal drawings provided by the manufacturer. Exact dimensions of the walls and ceiling are per the architectural drawings.
- B. Construction:
  - 1. The T-bar diffusers shall have coated steel construction shells, and extruded aluminum center tees and pattern controllers.
  - 2. The [blade type], [curved], or [ice tong] air pattern controller shall be field adjustable without the use of tools.
  - 3. The diffuser slot width shall be [1/2 inch], [3/4 inch], [1 inch], or [1-1/2 inch].
  - 4. Module sizes of 36 inches, 48 inches, and 60 inches shall have pattern controllers divided into two sections along the length, allowing split air patterns.
  - 5. The T-bar diffusers shall have integral supply air plenums. The plenums shall be manufactured of heavy gauge coated steel.
  - 6.
  - 7. The diffusers shall be equipped with [1 to 4] slots.
  - 8. The integral plenums shall be equipped with a side inlet collar, and shall be [insulated] or [uninsulated].
- C. Performance:
  - 1. Performance of the selected T-bar diffusers shall be based on catalogued data obtained with the pattern controllers set in the normal operating position, and tested in accordance with ASHRAE 70.
- D. Paint Specification:
  - 1. Paint finish shall be (**select one**):
    - a. All visible components shall have a baked-on powder coat finish.
      - 1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
      - 2. The paint film thickness shall be a minimum of 2.0 mils.
      - 3. The finish shall have a hardness of 2H.
      - 4. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
      - 5. The finish shall have an impact resistance of 80 inch-pounds.
    - b. All visible components shall have a custom baked enamel finish in a color to match a customer supplied sample.
    - c. All visible components shall have an anodized finish.
- E. Options (**select all that apply**):
  - 1. Border:
    - a. The diffuser shall include the following border type (**select one**):
      - 1. Center notch (**1 slot diffusers only**).
      - 2. Straddle tee (**2 or more slots only**).
      - 3. Straddle type and center notch (**2 or more slots only**).
  - 2. Face Finish:
    - a. The diffuser face finish shall be (**select one**):
      - 1. Black powder coat.
      - 2. Narrow flange mill finish (**Canada only**).
      - 3. Narrow flange black face finish (**Canada only**).
  - 3. Frame style:
    - a. The T-bar diffusers shall be supplied with the following frame style for T-bar lay in mounting (**select one**)
      - 1. T-bar clips on [inlet side] or [both sides].
      - 2. One outside T-bar on [inlet side] or [both sides].
  - 4. Mounting frame
    - a. The T-bar diffuser shall be supplied with an extruded aluminum plaster frame for surface mount installations.

## 2.03 Fire-Rated T-bar Supply Diffusers

- A. Description:
1. Furnish and install Price model TBD fire-rated T-bar supply diffusers in sizes and capacities as shown by the plans and air distribution schedule. Provide drawings accompanied by an itemized list indicating the unit locations and appropriate product submittal drawings provided by the manufacturer. Exact dimensions of the walls and ceiling are per the architectural drawings.
  2. Diffusers shall be Fire-Rated assemblies listed in the UL, Underwriters Laboratories Fire Resistance Directory and in the ULC, Underwriters Laboratories of Canada Equipment and Materials Directory. Diffusers shall meet UL time and temperature test criteria and NFPA 90A requirements.
  3. This design is intended for use in an exposed grid suspended ceiling (T-bar lay-in) with up to a three hour rating and must be installed in accordance with installation instructions.
- B. Construction:
1. The T-bar diffusers shall have coated steel construction shells, and extruded aluminum center tees and pattern controllers.
  2. The [blade type], [curved], or [ice-tong] air pattern controllers shall be field adjustable to create a one-way horizontal airflow pattern, or a vertical airflow pattern without the use of tools.
  3. Module sizes of 36 inches, 48 inches, and 60 inches shall have pattern controllers divided into two sections along the length, allowing split air patterns.
  4. The T-bar diffusers shall have integral supply air plenums. The plenums shall be manufactured of heavy gauge coated steel.
  5. The diffusers shall be equipped with [1 to 4] slots.
  6. The integral plenums shall be equipped with a side inlet collar, and shall be [insulated] or [uninsulated].
- C. Performance:
1. Performance of the selected T-bar diffusers shall be based on catalogued data obtained with the pattern controllers set in the normal operating position and a compatible Price supply air plenum, and tested in accordance with ASHRAE 70.
- D. Paint Specification:
1. Paint finish shall be (**select one**):
    - a. All visible components shall have a baked-on powder coat finish.
      1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
      2. The paint film thickness shall be a minimum of 2.0 mils.
      3. The finish shall have a hardness of 2H.
      4. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
      5. The finish shall have an impact resistance of 80 inch-pounds.
    - b. All visible components shall have a custom baked enamel finish in a color to match a customer supplied sample.
    - c. All visible components shall have an anodized finish.
- E. Damper:
1. The diffuser shall be supplied with a galvanized steel, non-adjustable, fire flap-type ceiling radiation damper.
- F. Options (**select all that apply**):
1. Fusible Link:
    - a. The diffuser shall be supplied with a fusible link rated for (**select one**):
      1. 165 degrees Fahrenheit.
      2. 212 degrees Fahrenheit.

## 2.04 T-bar Return Diffusers

- A. Description:
1. Furnish and install Price model TBR T-bar return diffusers in sizes and capacities as shown by the plans and air distribution schedule. Provide drawings accompanied by an itemized list indicating the unit locations and appropriate product submittal drawings provided by the manufacturer. Exact dimensions of the walls and ceiling are per the architectural drawings.
- B. Construction:
1. The T-bar diffusers shall have steel construction shells, and extruded aluminum center tees.
  2. The T-bar diffuser shall have integral air plenums manufactured of heavy gauge coated steel.
  3. Return units shall have [1], [2], [3], or [4] slots with [1/2 inch], 3/4 inch, [1 inch], or [1-1/2 inch] slot widths. The extruded aluminum center tee on the 2, 3, and 4 slot models shall be painted white.
  4. The integral plenums shall be [internally insulated with (fiber free) or (coated fiberglass insulation)] or [uninsulated].

- C. Performance:
1. Performance of the selected T-bar diffusers shall be based on catalogued data obtained with the pattern controllers set in the normal operating position, and tested in accordance with ASHRAE 70.
- D. Paint Specification:
1. Paint finish shall be (**select one**):
    - a. All visible components shall have a baked-on powder coat finish.
      1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
      2. The paint film thickness shall be a minimum of 2.0 mils.
      3. The finish shall have a hardness of 2H.
      4. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
      5. The finish shall have an impact resistance of 80 inch-pounds.
    - b. All visible components shall have a custom baked enamel finish in a color to match a customer supplied sample.
    - c. All visible components shall have an anodized finish.
- E. Options (**select all that apply**):
1. Border:
    - a. The diffuser shall include the following border type (**select one**):
      1. Center notch (**1 slot diffusers only**).
      2. Straddle tee (**2 or more slots only**).
      3. Straddle type and center notch (**2 or more slots only**).
  2. Frame style:
    - a. The T-bar diffusers shall be supplied with the following frame style for T-bar lay in mounting (**select one**)
      1. T-bar clips on [inlet side] or [both sides].
      2. One outside T-bar on [inlet side] or [both sides].
  3. Mounting frame:
    - a. The T-bar diffuser shall be supplied with an extruded aluminum plaster frame for surface mount installations.

## 2.05 Fire-Rated T-bar Return Diffusers

- A. Description:
1. Furnish and install Price model TBR-FR fire-rated T-bar return diffusers in sizes and capacities as shown by the plans and air distribution schedule. Provide drawings accompanied by an itemized list indicating the unit locations and appropriate product submittal drawings provided by the manufacturer. Exact dimensions of the walls and ceiling are per the architectural drawings.
  2. Diffusers shall be Fire-Rated assemblies listed in the UL, Underwriters Laboratories Fire Resistance Directory and in the ULC, Underwriters Laboratories of Canada Equipment and Materials Directory. Diffusers shall meet UL time and temperature test criteria and NFPA 90A requirements.
  3. This design is intended for use in an exposed grid suspended ceiling (T-bar lay-in) with up to a three hour rating and must be installed in accordance with installation instructions.
- B. Construction:
1. The T-bar diffusers shall have coated steel construction shells, and extruded aluminum center tees.
  2. The T-bar diffusers shall have integral supply air plenums. The plenums shall be manufactured of heavy gauge coated steel.
  3. The integral plenums shall be equipped with a side inlet collar.
  4. The diffusers shall be equipped with [1] or [2] slots.
  5. The center tee shall be painted white.
- C. Performance:
1. Performance of the selected T-bar diffusers shall be based on catalogued data obtained with the pattern controllers set in the normal operating position and a compatible Price supply air plenum, and tested in accordance with ASHRAE 70.
- D. Paint Specification:
1. Paint finish shall be (**select one**):
    - a. All visible components shall have a baked-on powder coat finish.
      1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
      2. The paint film thickness shall be a minimum of 2.0 mils.
      3. The finish shall have a hardness of 2H.
      4. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
      5. The finish shall have an impact resistance of 80 inch-pounds.

- b. All visible components shall have a custom baked enamel finish in a color to match a customer supplied sample.
  - c. All visible components shall have an anodized finish.
- E. Thermal Blanket:
  - 1. The diffuser shall be externally wrapped with a non-asbestos thermal blanket.
- F. Options (**select all that apply**):
  - 1. 14 inch oval duct
  - 2. Fusible Link:
    - a. The diffuser shall be supplied with a fusible link rated for (**select one**):
      - 3. 165 degrees Fahrenheit.
      - 4. 212 degrees Fahrenheit.

### **PART 3 – EXECUTION**

#### **3.01 Examination**

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as shown on the drawings.

#### **3.02 Installation**

- A. Install in accordance with manufacturer's instructions.
- B. See drawings for the size(s) and locations of diffusers.

#### **3.03 Field Quality Control**

- A. See Section 01 40 00 – Quality Requirements for additional requirements.

#### **3.05 Cleaning**

- A. See Section 01 74 19 – Construction Waste Management and Disposal for additional requirements.

#### **3.06 Closeout Activities**

- A. See Section 01 78 00 – Closeout Submittals for closeout documentation requirements.
- B. See Section 01 79 00 – Demonstration and Training for addition.

**23 7433****Indoor Horizontal****Dedicated Outside Air System (DOAS) Fully Integrated DX System with Energy  
Recovery****ENGINEERING GUIDE SPECIFICATION****AIR-COOLED, AIR SOURCE HEAT PUMP UNIT**

Note: Specifications are for the Alpha Aire Indoor Horizontal DOAS unit designed. Alternate manufacturers will be evaluated and accepted or rejected based on their similarity with these specifications. Alternates may be submitted before or after bid however if after bid it is at the contractors risk of alternate being rejected.

**Part 1 – General****1.01 Related Documents**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

**1.1 General Description**

- A. Furnish and install an indoor horizontal dedicated outside air system (DOAS) designed to provide fresh air into the conditioned space. It shall have the performance, electrical characteristics, and air path configurations as defined in the product schedule for the space.
- B. The unit(s) shall be an Alpha Aire air-cooled system manufactured by United CoolAir, York, Pennsylvania.
- C. The unit(s) shall be installed as a ceiling/slab mounted self-contained system in conjunction with the space air conditioner system.
- D. All systems shall be shipped with a factory refrigerant charge and be ready to wire once the units have been placed on site.
- E. A wiring diagram shall be affixed to each unit. A printed Installation, Operation and Maintenance Manual shall be provided with each unit. All units shall be

suitably labeled for safety purposes and for access. A web based wiring diagram shall be available.

## **1.2 Quality Assurance**

- A. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236-11, safety Standard for Heating and Cooling Equipment.
- B. Units shall be factory evacuated, charged with refrigerant R-410A, leak tested, and functionally tested prior to shipment.

## **1.3 Submittals**

- A. Literature shall be provided that indicates unit dimensions, applicable clearances, unit operating weights, capacities, blower performance, filter information, factory supplied options, electrical characteristics, and connection requirements.
- B. Installation, Operation, and Maintenance manual shall be provided.

## **1.4 Delivery, Storage, and Handling**

- A. Unit(s) shall be shipped with all access panels in place and suitably affixed to prevent damage during transportation and thereafter while in storage either offsite or on the jobsite.
- B. Units are to be inspected upon delivery and prior to signing receipt accepting equipment.
- C. Unit(s) shall be stored in a clean, dry place protected from construction traffic and the natural elements.
- D. Installing contractor shall follow industry accepted practices and instructions in the Installation, Operation and Maintenance manual for moving unit(s) where required.

- E. Unit or any portion of the unit shall not be disassembled in the field, except as designed for, in order to facilitate placement into the building or mechanical space. Any disassembly of the unit or unit sections not incorporated into the basic design would act to void the unit warranty and reduce the factory quality assurance process.

### **1.5 Warranty**

- A. Manufacturer shall provide a “parts only” limited warranty for a period of 12 months from the date of equipment start-up or 18 months from date of shipment from the factory, whichever is less.
- B. Manufacturer shall provide a “compressor parts only” limited warranty for a period of 60 months from the date of equipment start-up or 66 months from date of shipment from the factory, whichever is less.
- C. Manufacturer’s limited warranty shall be for parts only. Labor is not included. Follow the manufacturer’s Warranty Manual.

## **Part 2 – Products**

### **2.1 Alpha Aire Cabinet**

- A. Cabinet shall be painted non-weatherized and constructed of scratch resistant heavy duty galvanized G90 steel. Exterior structural members and access panels shall be of wet paint post construction.  
  
Color shall be Rohm & Haas, Corvel 244-0253 Stormy Gray or approved equal. Wet paint exterior only.
- B. Cabinet shall be shipped as a self-contained unit on a single skid from the manufacturer. Cabinet shall be assembled using zinc plated fasteners.
- C. Unit shall be provided with integral support rails and integral hanging brackets which eliminate the need for external, field-supplied brackets. Brackets shall accommodate the unit being ceiling mounted using hanging rods or slab mounted.
- D. Cabinet access panels shall fit into recessed pockets within the cabinet structure and held in place with screws or tool-operated quick-turn fasteners. Recessed

areas will be lined with flexible gasket to minimize air leakage. Some access panels shall have inserts to easily facilitate panel removal. Service panels for filter maintenance are hinged for ease of service.

- E. Panels shall allow side access to key internal components to facilitate installation, maintenance and servicing of the unit. The front end panel will be hinged to allow for ease of access.
- F. Duct flanges shall be factory-installed prior to shipment for side supply and exhaust/return air configurations. This side panel is field reversible and duct flanges and panel gasket must be moved for opposite side supply and exhaust/return air configuration.
- G. The back of the cabinet shall have an inlet and outlet for outside air intake and exhaust air discharge. The cabinet shall be suitable for installation adjacent to an exterior wall or interior space within the building.
- H. Cabinet and removable panels shall be lined with 2", R-8 fiberglass, solid double wall thermal/acoustic insulation and ¼" rubberized PVC. Insulation shall not promote or support the growth of fungi or bacteria. Insulation shall include an acrylic polymer coating to help guard against the incursion of dust and dirt into the substrate.
- I. Double Wall with Solid Liner - Cabinet and removable panels shall be double-wall construction with interior panels consisting of solid galvanized metal.

## **2.2 Enthalpy Wheel**

- A. The system shall utilize a total enthalpy wheel to capture waste heat energy from the building exhaust air stream for conditioning of the entering outdoor air stream. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt. The wheel shall not allow more than 5% crossover between the supply and exhaust air stream. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity. The wheel shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing

laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. The wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

### **2.3 Plate Heat Exchanger**

A. The plate heat exchanger will have a maximum temperature of 190°F. The plate heat exchanger shall have a maximum leakage of 0.1% at nominal air flow with non-silicone sealant at 400 Pa WC differential pressure. The plate material shall be aluminum. The frame material corner profiles shall be aluminum or aluzinc.

### **2.4 Refrigerant Circuit**

- A. Refrigerant circuit shall be provided with high and low-side Schrader access valves, sight glass with integral moisture indicator, filter-drier, maximum operating pressure (MOP) expansion valve with external equalizer line, expansion valve with internal equalizer line, manual reset high and auto-reset low pressure safety switches.
- B. Refrigerant circuit will be factory leak tested, evacuated, and charged with R-410A refrigerant and run tested prior to shipment.
- C. Units shall contain a 1-row auxiliary/reheat coil and a receiver tank for refrigerant management. The auxiliary/reheat coil shall be constructed of copper tubing mechanically expanded into aluminum fins. The fin spacing shall be 13 fins per inch. The auxiliary/reheat coil shall be vertically mounted a minimum of 8" after the evaporator coil for ease of cleaning and to prevent re-hydration of the condensate from the evaporator coil.

- D. The Compressor section is to be provided with resealable refrigerant fittings in order to allow for compressor change at the ceiling level requiring no recovery of refrigerant, brazing, and evacuation or charging of the unit using a factory compressor retrofit kit.
- E. Heat Pump Cycle unit will be equipped with a solenoid valve operating a 4 way valve. In addition the refrigeration circuit will shall contain a suction accumulator.

## **2.6 Compressor**

- A. Refrigerant circuit (.75 ton) shall utilize a single reciprocating compressor. Reciprocating compressors shall be mounted on vibration isolators to ensure quiet operation. Each reciprocating compressor shall be protected internally from overheating.
- B. Compressor shall be mounted outside the air stream in an insulated compartment.
- C. Compressor circuit shall be protected with a high and low pressure safety switch.

## **2.7 Evaporator Coil Section**

- A. It shall be made with heavy wall seamless copper tubes mechanically expanded into tempered aluminum fins with drawn self-spacing collars. Coil end sheets shall be hot-dipped galvanized. Coils shall be 6 rows deep and 13 FPI for uniform performance and optimum part load and humidity operation. All coils shall be factory leak checked under pressure.
- B. A maximum operating pressure (MOP), adjustable thermostatic expansion valves, externally equalized, shall feed the evaporator coil.
- C. Evaporator coil section shall be equipped with a double sloped 304 stainless steel drain pan with 3/4" NPT female connection condensate drain connection located on the side of the cabinet. Drain pan shall extend to the entire length and width of the evaporator coil.
- D. Evaporator section air path shall be as shown on project drawings.

## **2.8 Condenser Coil Section**

- A. It shall be made with heavy wall seamless copper tubes mechanically expanded into tempered aluminum fins with drawn self-spacing collars. Coil end sheets shall be hot-dipped galvanized. Coils shall be 4 rows deep and 18 FPI for uniform performance and optimum part load and humidity operation. All coils shall be factory leak checked under pressure.
- B. A maximum operating pressure (MOP), adjustable thermostatic expansion valve, internally equalized shall feed the evaporator coil.
- C. Condenser coil section shall be equipped with a double sloped 304 stainless steel drain pan with 3/4" NPT female connection condensate drain connection located on the side of the cabinet. Drain pan shall extend to the entire length and width of the condenser coil.

## **2.7 Blower / Motor Assemblies**

- A. Alpha Aire unit shall incorporate ECM blowers.
- B. The unit supply and exhaust fans shall consist of centrifugal backward curve fans with electronically commutated motors (ECM). The motor RPM shall be directly set by the package unit control system. The balancing contractor shall have direct access to set the motor RPM through the unit control system
- C. Section shall include a factory-installed, fan motor fault proving switch. Upon loss of fan motor operation, this control shall enunciate.

## **2.8 Electrical System**

- A. Alpha Aire unit shall have a single isolated electrical control panel located out of the air stream. Access to the control panel shall be from the right or left side of the unit. A single point power connection shall be provided through the right or left side of the cabinet. Power shall be connected to factory installed terminal blocks. Ground lug shall be affixed in the control panel.
- B. A low-voltage transformer, with protection, shall be provided to supply 24 VAC to the control circuit.

- E. Terminal strips and blocks shall be factory installed internal to the control box and be clearly labeled for control wiring connections. External control wires shall enter the cabinet through the right or left side of the cabinet.
- F. Terminal blocks shall be factory provided for a Remote On / Off switch capability. Controls shall be suitably wired and enabled to accept a signal from a field supplied Remote On / Off switch.
- G. Terminal blocks shall be factory provided for a Fire / Smoke Detector sensor interface. Controls shall be suitably wired and enabled to accept a signal from a Fire / Smoke Detector.
- H. Terminal blocks shall be factory provided for an External Condensate Pump / Float Switch interface. Controls shall be suitably wired and enabled to accept a signal from an External Condensate Pump / Float Switch.
- I. The unit shall contain a self-contained programmable thermostat.

## **2.9 Alpha Aire Air Filtration**

- A. The filter shall be factory mounted in the unit cabinet and shall be accessible from either side.
- B. Filters shall be nominal 2" depth pleated, throwaway type panel filters consisting of cotton and synthetic or synthetic only media with galvanized expanded metal backing and moisture resistant enclosing frame. The filter shall be classified for flammability by Underwriters Laboratories, Inc. as Class 2.
- C. The filter media shall have an efficiency of MERV 8 based on ASHRAE test standard 52.2.
- D. The filter face area shall contain not less than 10 pleats per lineal foot. Media support shall be heavy gauge expanded, electro-galvanized metal with grid members being no less than 0.025" wide, providing an open area of not less than 96%. The grid shall be 100% bonded to the media on the air exiting side to eliminate media vibration and pull-away. The grid shall be formed to provide a uniform V-shaped pleat with the open area on the air exiting matched to the open area on the air entering side for maximum utilization of the media and low airflow resistance. The enclosing frame shall be constructed of a rigid, high wet strength board.

## **2.10 System Options**

- A. CO<sub>2</sub> Switch – Wall mounted non-dispersive infrared carbon dioxide (CO<sub>2</sub>) sensor shall be factory provided for field (duct or wall) installation. The CO<sub>2</sub> sensor shall measure environmental carbon dioxide levels for use in demand-controlled ventilation, air-quality monitoring, and other HVAC applications in accordance with ASHRAE standards. Fully isolated analog outputs and a convenient center wiring terminal shall make installation both simple and trouble-free. The analog output shall be jumper-selectable, 4-20 mA or 0-10 VDC, over the industry standard 0-2000 ppm CO<sub>2</sub> range. LCD display and control relay with adjustable set point shall be provided.
- B. Condensate Pump - A condensate pump for the automatic collection and removal of condensate from the unit shall be factory provided. Pump shall be shipped loose for field mounting. Pump shall consist of a 1/30 H.P. high performance motor, a ½ gallon ABS housing and cover, ABS collection tank, vertical centrifugal pump with glass-filled polypropylene impeller and stainless steel shaft, check valve, power cord and automatic controls.

A separate 115-1-60 power supply for the condensate pump is to be field-provided.

## **Part 3 – Factory Testing**

### **3.1 Functional Run Test**

- A. Each complete system shall be functionally run-tested prior to shipment. A dielectric withstand test shall also be conducted. All data is to be recorded on a factory test form and shall include all electrical components, motors, compressors, safeties, controls, along with refrigerant pressure and electrically operated options.
- B. Refrigerant circuit shall have a complete refrigerant circuit leak test and all data is to be included in the factory test form(s).
- C. Upon request, a copy of the factory Unit Test Sheet shall be provided.

- D. A final inspection prior to shipment is also to be conducted and documented.

## **Part 5 - Execution**

### **5.1 Installation, Operation and Maintenance**

- A. Installation, Operation and Maintenance manual shall be provided with the unit.
- B. Installing contractor shall install unit in accordance with industry accepted practices and Installation, Operation and Maintenance Manual. A licensed HVAC contractor is required to install and commission United CoolAir equipment.
- C. Industry accepted Start-Up procedures and requirements shall be complied with to ensure safe and reliable operation of the unit.
- D. United CoolAir Start Up sheets must be filled out by installing contractor and submitted to local Authorized United CoolAir Distributor for record.

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## **Part 1 - General**

Note: Specifications are for the city-multi system designed. Alternate manufacturers will be evaluated and accepted or rejected based on their similarity with these specifications. Alternates may be submitted before or after bid however if after bid it is at the contractors risk of alternate being rejected.

### **1.01 SYSTEM DESCRIPTION R2-SERIES (SIMULTANEOUS HEAT/COOL)**

- A. Per the equipment schedule, the variable capacity, heat pump heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).
- B. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.
- C. Simultaneous heating/cooling (heat recovery) systems shall consist of an outdoor unit, BC (Branch Circuit) Controller (or comparable branch devices), multiple indoor units, and an integral DDC (Direct Digital Controls) system. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes.
- D. No additional branch circuit controllers (or comparable branch devices) than shown on the drawings/schedule may be connected to any one outdoor unit. Contractors proposing alternate systems requiring more branch devices than those included as the basis of design are responsible for additional piping &

electrical costs and are required to identify additional costs & installation time required of other trades with their bid.

## 1.02 QUALITY ASSURANCE

1. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
4. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
5. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

## 1.03 DELIVERY, STORAGE AND HANDLING

1. Unit shall be stored and handled according to the manufacturer's recommendation.

## **Part 2 - Warranty**

- A. The CITY MULTI units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
- B. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10)

years to the original owner from date of installation. This warranty shall not include labor.

- C. Manufacturer shall have a minimum of fifteen (15) years continuous experience providing VRF systems in the U.S. market.
- D. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required.

Registering and sign-in requirements which may delay emergency service reference are not allowed.

- E. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

### **Part 3 - Outdoor Units**

#### **3.01 R2-SERIES STANDARD EFFICIENCY (HEAT RECOVERY), AIR COOLED OUTDOOR UNITS**

##### **A. General:**

The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
2. Outdoor unit shall have a sound rating no higher than 66.5 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
3. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

4. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
5. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
6. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
7. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
8. The outdoor unit shall be capable of operating in heating mode down to -18°F ambient temperatures or cooling mode down to 23°F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
9. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.
10. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.
11. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature. Systems that keep fans running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

12. In reverse defrost all refrigerant shall be bypassed in the main branch controller and shall not be sent out to the indoor units, systems that flow refrigerant through indoor units during reverse defrost shall not be allowed.

B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
2. Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit assembly to ensure manufacturer quality standards are not compromised and shall meet the following minimum requirements:
  - $\geq 85\mu\text{m}$  thermoset polyester-resin powder coating on External Front Panel
  - $\geq 70\mu\text{m}$  thermoset polyester-resin powder coating on External Panel Base, Pillar, Compressor Cover, Fan Motor Support, Electrical Box
  - $\geq 1\mu\text{m}$  cellulose and polyurethane-resin coating on heat exchanger fins
  - $\geq 10\mu\text{m}$  polyurethane coating on printed circuit boards
3. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
4. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

C. Fan:

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fans shall be provided with a raised guard to prevent contact with moving parts.

D. Refrigerant and Refrigerant Piping:

1. R410A refrigerant shall be required for systems.
2. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
5. Refrigerant line sizing shall be in accordance with manufacturer specifications. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.

E. Coil:

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
2. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
3. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
4. The coil fins shall have a factory applied corrosion resistant blue-fin finish. Uncoated aluminum coils/fins are not allowed.

5. The coil shall be protected with an integral metal guard.
  6. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
  7. Unit shall have prewired plugs for optional panel heaters when operating below ambient conditions of 1F to prevent any residual ice buildup from defrost.
- F. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to

protect coil from freezing shall not be allowed in markets where the outdoor unit will see temperatures below freezingCompressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.
2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.
3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturer's that utilize belly-band crankcase heaters will be considered as alternate only.
4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.
5. The compressor shall be equipped with an internal thermal overload.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.
7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

G. Controls:

8. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
9. Each outdoor unit module shall have the capability of 4 levels of demand control based on external input.

#### H. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

### 3.02 BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR SIMULTANEOUS HEAT/COOL SYSTEMS

#### A. General

1. BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.
2. BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL1995 ed 4.

#### B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

#### C. Refrigerant Piping (specifications in addition to those for outdoor unit):

1. All refrigerant pipe connections shall be brazed.
2. Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing. Systems which might require future piping changes between branch device and outdoor unit—if changes to indoor unit quantities or sizes are made—are not considered equal and are not allowed.

D. Refrigerant valves:

1. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

E. Condensate Management:

1. BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs. Cabinets filled with solid foam insulation do not allow for future service and are not allowed.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
2. The BC Controller shall be controlled by integral microprocessors
3. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total.
- 4.

**Part 4 - Indoor Units**

**4.01 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT**

A. General:

1. The ceiling-recessed indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. Unit Cabinet:

1. The cabinet panel shall have provisions for a field installed filtered outside air intake.
2. Branch ducting shall be allowed from cabinet.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
4. The grille vane angles shall be individually adjustable from a wired remote controller to customize the airflow pattern for the conditioned space

C. Fan:

1. The indoor fan shall be an assembly with a statically and dynamically balanced turbo fan direct driven by a single motor with permanently lubricated bearings.
2. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
3. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
4. The indoor unit fan logic must include multiple setting that can be changed to provide optimum airflow based on ceiling height and number of outlets used.
5. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.

6. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
7. Grille shall include a factory-installed "i-see" sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
3. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
4. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.
5. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

#### 4.02 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE FOR 2X2 GRID INDOOR UNIT

##### A. General:

1. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

##### B. Unit Cabinet:

1. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

##### C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (4) speed settings, Low, Mid, High and Auto.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
6. Grille shall include a factory-installed "i-see" sensor, or equal, to work in conjunction with indoor unit control sequence to prevent unnecessary cooling or heating in unoccupied areas of the zone without decreasing comfort levels. Sensor must detect occupancy (not simply motion) and location of occupants by measuring size & temperature of objects within a 39' detecting diameter (based on 8.8ft mounting height) with 1,856 or more measuring points.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
3. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
4. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.
5. A factory-installed drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur, the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

#### 4.03 VERTICAL/HORIZONTAL DUCTED (MULTI-POSITION AIR HANDLER)

A. General:

1. The multi-position indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4<sup>th</sup> Edition, be tested in accordance with ANSI/ASHRAE 193 and have less than 2% air leakage at maximum airflow setting.

B. Unit Cabinet:

1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel.

C. Fan:

1. The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a high efficiency DC motor with permanently lubricated bearings.
2. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.WG selectable.

D. Filter:

1. The unit shall have a 1" filter rack with a reusable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F deadband from set point.
- 2.

**Part 5 - Controls**

## 5.01 OVERVIEW

- A. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC

connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

- B. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
- C. System shall be capable of email generation for remote alarm annunciation.

## 5.02 ELECTRICAL CHARACTERISTICS

### A. General:

- 1. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.

### B. Wiring:

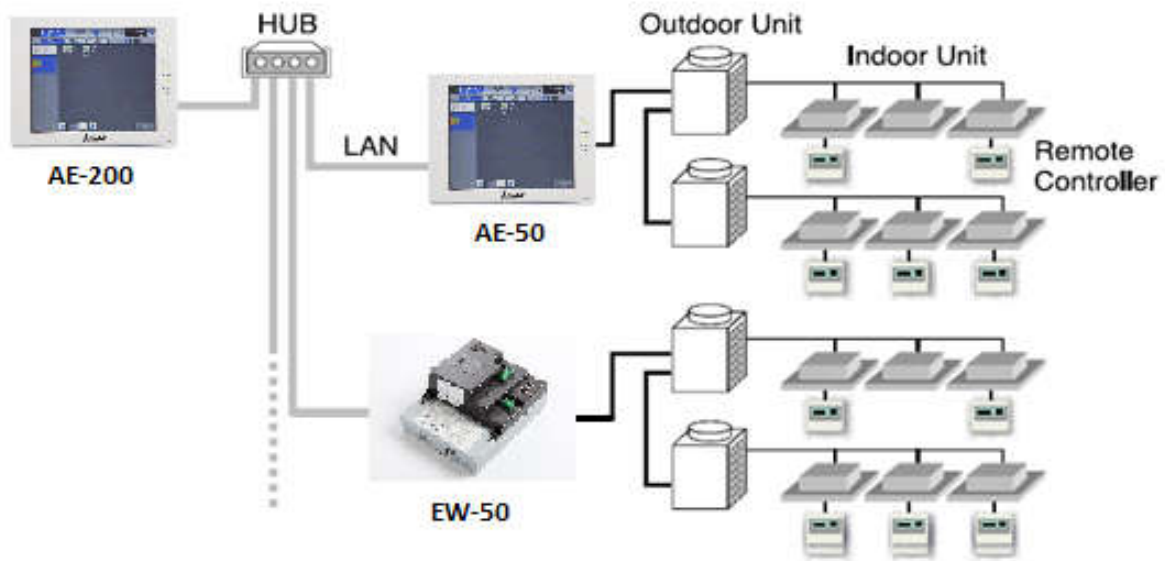
- 1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
- 2. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

### C. Wiring type:

- 1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
- 2. Network wiring shall be CAT-5 with RJ-45 connection.

## 5.03 CITY MULTI CONTROLS NETWORK

- 1. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



**CMCN System Configuration**

## 5.04 GRAPHICAL USER INTERFACE

- A. The Graphical User Interface (Integrated Centralized Control Web) shall require a field supplied PC or Tablet.
- B. ICCW
1. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple AE-200, AE-50, EW-50's and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty AE-200/AE-50/EW-50 Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 AE-200/AE-50/EW-50 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per AE-200/AE-50/EW-50 Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

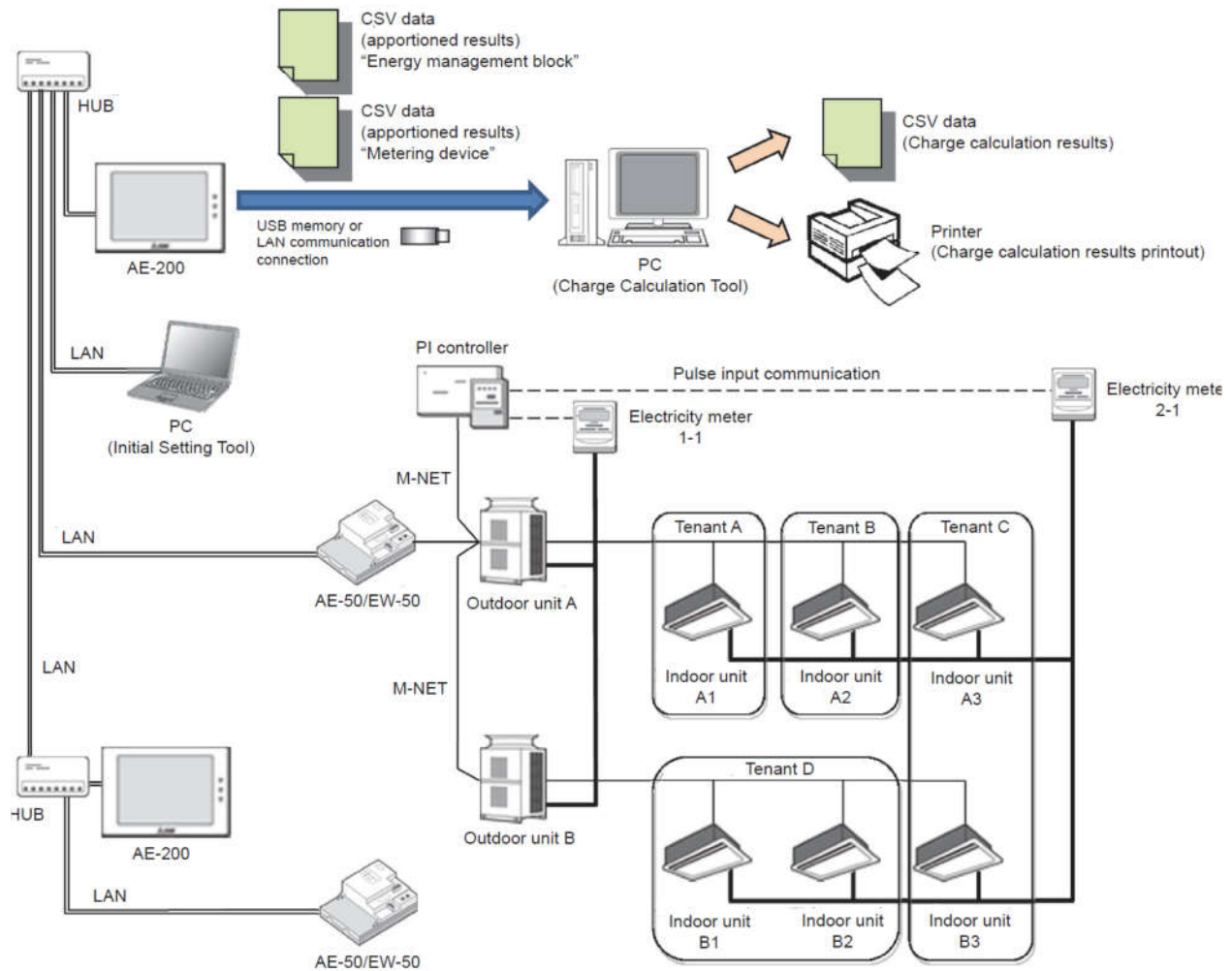
ICCW (Integrated System Software)	
Item	Details
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model.  Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)

Interlocked Unit ON/OFF LOSSNAY	If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	<p>A watt-hour meter (WHM) with kWh pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day.</p> <p>***OPTIONAL ENERGY APPORTIONMENT SOFTWARE (SW-CHARGE) and PI Controller (PAC-Y60MCA) REQUIRED</p>
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display Mask	The filter sign display at the remote controllers can be disabled.
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

## 5.05 CMCN: SYSTEM INTEGRATION

- A. The CMCN shall be capable of supporting integration with Building Management Systems (BMS) via industry standard communication protocols including BACnet and LonWorks®.

## 5.06 ENERGY APPOINTMENT METHOD FOR CITY MULTI CENTRALIZED CONTROLLERS



**CMCN System Configuration**

## A. System Overview

1. For centralized systems serving multiple tenants for which one-to-one electricity metering is not possible, an apportioned electricity billing function that attributes just the electrical energy consumed by each individual tenant's air conditioner is required. The Energy Apportionment function takes the information on the electrical energy usage gathered from Watt Hour Meters (WHM) connected to dedicated breaker panels serving the system's outdoor units and synthesizes it with the information on the operating status of the indoor units that is collected by the CITY MULTI centralized controller(s).

## B. Watt Hour Meters

### 1. Requirements:

- The Watt Hour Meters (WHMs) to be used to read the electrical energy consumption of the outdoor units must be capable of a pulse output, which would be configured based on the current rating of the units. The associated current transformers/ transducers (CTs) must also be sized based on the current rating of either the individual outdoor units or the dedicated air conditioning electrical panels they are to be reading. The proper quantity of meters for a particular sized system must be selected in order to ensure sufficient resolution and hysteresis in the unit pulse output of the meters so as to ascribe an acceptable level of accuracy to the apportionment of energy usage for each tenant's system. The system is designed to work with any WHM capable of a pulse output that meets ANSI C12.20 class 0.2% or 0.5% accuracy standards.

### 2. Connection:

- The WHMs are to be physically connected to the integrated pulse input module or an external Mitsubishi Electric PI Controller if such an input is not available or if there is a wiring length limitation or installation hardship. The cable type of the interconnecting wiring shall be according to the wiring specifications of the WHM manufacturer.

## C. CITY MULTI Centralized Controller Requirements

### 1. Licensing:

- Each centralized controller (AE-200/AE-50/EW-50) to which units are assigned that require the energy apportionment function must have the “SW-Charge” software license purchased and properly unlocked in order to enable the operating status of the indoor units to be passed to the energy apportionment tool. The procedure for licensing the centralized controllers with this function and the necessary forms can be found on Mitsubishi Electric’s technical documentation repository, [mylinkdrive.com](http://mylinkdrive.com). Purchase Order information for the licenses will be required at the time of submission of the licensing request forms.

## 2. Dedicated AE-200 for apportionment (no MNET connection)

- A dedicated AE-200 centralized controller, for which the SW-Charge license is purchased and the energy apportionment function enabled, must be provided in order to serve as the portal for exporting metering device and energy management data to a USB drive or to a PC via LAN connection. This means that by virtue of selecting this AE-200 to serve this function, the MNET capability of this particular centralized controller will be disabled. All indoor units must be physically wired via MNET to other centralized controllers (AE-50/EW-50), which must be physically wired via LAN with Static IP addresses and a network hub or switch to the AE-200 Apportionment controller.

## D. PC for collecting charge calculation results

- A networked PC, which does not necessarily have to be dedicated to the task of collecting energy apportionment data, can be provided and loaded with the Charge Calculation Tool software for exporting data necessary to generate billing documentation to be performed by a third party. The system requirements of the PC are as follows:

Item	Requirements
CPU	1 GHz or better (at least 2 GHz recommended)
Memory	2GB or more
Screen Resolution	1024 x 768 or better
OS	Windows 7, Windows 8.1 (32bit/64bit)
System requirements	<p>The system should meet the minimum requirement for Windows 7 or Windows 8.1</p> <ul style="list-style-type: none"> <li>• Net Framework 4.5 or later</li> </ul>
Internal LAN port or LAN card	100 BASE-TX or better

Porting device	Mouse, etc.
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## 5.07 CMCN: REMOTE CONTROLLERS

### A. Smart ME Remote Controller (PAR-U01MEDU) :

1. The Smart ME Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
2. The ME Remote Controller shall only be used in same group with other ME Remote Controllers with a maximum of two ME Remote Controllers per group.

PAR-U01MEDU (Smart ME Remote Controller)			
Item	Description	Operation	Display
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Backlight	Turns on when screen is touched. Timeout duration is adjustable.	Each Group	Each Group
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Room Temp and Humidity Display	Displays the room temperature and humidity on the Home screen. Temperature and Humidity sensed can be calibrated using the sensor offset in 1 °F or 1% RH increments.	N/A	Each Group
Occupancy Sensor	Detects occupancy using an infrared motion sensor. Occupancy status is indicated on the remote controller and through the web interface depending on connected equipment. Sensitivity is adjustable.	N/A	Each Group
Brightness Sensor	Detects brightness in the space and indicates brightness on the remote controller and through the web browser interface depending on connected equipment. Sensitivity is adjustable.	N/A	Each Group
Status Monitor	Displays the status of general equipment control points connected to the Advanced HVAC Controller (DC-A2IO)	N/A	Each Group

Humidity Setting	Sets the relative humidity set point in 1% increments for any humidifier connected to the Advanced HVAC Controller (DC-A2IO)	Each Group	Each Group
LED Indicator	Can be set to indicate the operation status by lighting and flashing with different colors and brightness or by turning off to signal operation mode, stopped unit, error, occupancy, or home screen button pushes. Color can be set to indicate the current mode selected or room temp range being sensed. *Available colors include blue, light blue, yellow, white, green, red, and lime.	Each Group	Each Group
Schedule	Set up to 8 operations per day, 7 days per week. Operations include time on/off, mode and room temperature set point.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction, Reset filter). *1: Operation icon lights up on the remote controller for prohibited functions.	N/A	Each Group *1
Energy-Save control during vacancy	When vacancy is detected by the occupancy sensor 5 control options are available for selection:  Stop/Setback Mode/Set Temperature Offset/Low Fan Speed/Thermo-off  Brightness sensor can be used in conjunction with the occupancy sensor to increase accuracy.	Each Group	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode.	Each Group	Each Group
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit. LOSSNAY items that can be set are "Hi", "Low", and "Stop". Ventilation mode switching is not available.	Each Group	Each Group
Set Temperature Range Limit	Set temperature range limit for auto, cool (drying) and heat modes.	Each Group	Each Group
Operation Lock Out Function	Locking of ON/OFF, Mode, Set Temp, Hold button and Air Direction.	Each Group	Each Group
Password	User and Service password protections are available	Each Group	N/A
Hold	Hold Prohibits the scheduled operation from being executed a. ON/OFF timer b. Auto-OFF timer c. Weekly timer d. Automatic return to the preset temperature	Each Group	Each Group

	* While an operation is prohibited by Hold function, the operation icon lights up.		
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**B. Simple MA Remote Controller (PAC-YT53CRAU):**

1. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers (PAR-FL32MA-E / PAR-FA32MA-E) or with other Backlit Simple MA Remote Controllers (PAC-YT53CRAU), with up to two remote controllers per group.

<b>Simple MA Remote Controller</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit.  Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit

Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display "test run").	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

3.

## 5.08 CENTRALIZED CONTROLLER (WEB-ENABLED)

### A. AE-200 Centralized Controller:

1. The AE-200A Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three (3) AE-50A expansion controllers. The AE-200A Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The AE-200A Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the AE-200A Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the AE-200 Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the AE-200A provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the AE-200A Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

<b>AE-200 (Centralized Controller)</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of Lossnay unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group

Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group

Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.	Each Group	Each Group
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: “Batch start/stop”, “Batch emergency stop” By pulse: “batch start/stop”, “Enable/disable remote controller” Output: “start/stop”, “error/Normal”	*5 Collective	*5 Collective

	*5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.		
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2. All AE-200A Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three AE-50A expansion controllers for display of up to two hundred (200) indoor units on the main AE-200A interface.
3. The AE-200A Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.
4. Standard software functions shall be available so that the building manager can securely log into each AE-200A via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require TG-2000 Integrated System software in conjunction with the Centralized Controllers.

B. AE-50A Expansion Controller:

1. The AE-50A Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the AE-200A Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the AE-200A. Up to three (3) AE-50A expansion controllers can be connected to the AE-200A via a local IP network (and their IP addresses assigned on the AE-200A) to the AE-200A to allow for up to two hundred (200) indoor units to be monitored and controlled from the AE-200A interface.
2. The AE-50A expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the AE-200A and configured to display their units on the main controller, the individual indoor units connected to the AE-50A can still be monitored and controlled from the interface of the AE-50. The last command entered will take precedence, whether at the wall controller, the AE-50A or the AE-200A Centralized Controller.

C. EW-50GU Centralized Controller:

1. The EW-50 Centralized Controller shall be capable of controlling a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The EW-50 Centralized Controller shall be approximately 8-1/2"x10" in size and shall be powered from the external power supply (PAC-SC51KUA). The EW-50 Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, free contact interlock configuration and malfunction monitoring. The EW-50 Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the EW-50 Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, temperature setting, fan speed setting, and airflow direction setting. Since the EW-50 provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the EW-50 Centralized Controller shall allow the user to define both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

<b>EW-50 (Centralized Controller)</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Indoor unit modes: COOL/DRY/FAN/AUTO/HEAT. Lossnay unit modes: HEAT RECOVERY/BYPASS/AUTO Air to water (PWFY) modes: HEATING/HEATING ECO/HOT WATER/ANTI-FREEZE/COOLING *Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit model.  Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Each Block, Group or Collective	Each Group

Set Temperature Range Limit	The range of room temperature setting can be limited by the initial setting depending on the indoor unit connected.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depend on indoor unit model.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	*Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *2. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority. Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition. Five types of weekly schedule (seasonal) can be set. Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Hold	Disables scheduled functions for indoor unit groups and their associated remote controller timers. *not available for general equipment	Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Fan Speed, Air Direction and Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group.	N/A	Each Group
Room Humidity	Displays the percent relative humidity in the space as sensed by the Smart ME Remote Controller	N/A	Each Group

Occupancy Sensor	Displays the occupancy icon on the group icon in the condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.	N/A	Each Group
Brightness Sensor	Displays the brightness icon on the group icon in the condition list when the space is determined to be bright (yellow) or dark (gray). *The Smart ME Remote Controller Brightness sensor is required.	N/A	Each Group
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Ventilation Equipment	This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between "Hi", "Low" and "Stop". When setting a group of only free plan LOSSNAY units, you can switch between "Normal ventilation", "Interchange ventilation" and "Automatic ventilation".	Each Group	Each Group
Multiple Language	Other than English, the following language can be chosen. Spanish, French, Japanese, German, Italian, Russian, Chinese, and Portuguese are available.	N/A	N/A
External Input / Output	By using accessory cables you can set and monitor the following. Input: By level: "Batch start/stop", "Batch emergency stop"; By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective
M-Net	The "M-NET" LED lights, when AC power supply is turned ON. The LED blinks while M-NET is communicating.	N/A	Each Group (LED)
Collective ON/OFF	All the units can be operated / stopped with a DIP switch.	Collective	N/A

Measurement	Displays the Temperature and Humidity inputs of the AI Board. Supports graph display and data export.	N/A	Each Unit
AHC Status	Displays the status of the of the inputs and outputs of each Advanced HVAC Controller (DC-A2IO)	N/A	Each Unit
Free Contact Status	Displays the input/output status of the Free Contacts on the indoor units	N/A	Each Unit
Free Contact Interlock Control	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free contact(s) input states.	Each Group, Output or Collective	N/A
Data Back-up (PC)	Initial setting data can be exported to a PC.	Collective	N/A

2. All EW-50 Centralized Controllers shall be equipped with two RJ-45 Ethernet port to support interconnection with a network PC and BACnet/IP communication via a closed/direct Local Area Network (LAN). The EW-50 Centralized Controller shall be capable of performing initial settings online via a PC using the EW-50 Centralized Controller's initial setting browser or online/offline with the Initial Setting Tool.
3. Standard software functions shall be available so that the building manager can securely log into each EW-50 via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions of personal browser for PCs and MACs and Energy Allocation shall be available. The Energy Allocation function shall require AE-200 Energy Allocation Integrated System in conjunction with EW-50 Centralized Controllers.

5.09

#### 5.10 CMCN REMOTE CONTROLLERS: SYSTEM INTEGRATION

1. The CMCN shall be capable of supporting integration with Building Management Systems (BMS).

#### D. LMAP04U: LonWorks® Interface:

1. The Mitsubishi Electric Cooling & Heating LonWorks® interface, LMAP04U, shall support up to fifty indoor units with a variety of network variables on a per indoor unit basis. Input variables include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, and filter sign reset. Output variables include, but are not limited to, model size, alarm state, error code, and error address.

