

**King and Parks Multi-Family Residences**  
**PERMIT SET**

TABLE OF CONTENTS

November 15, 2017

DIVISION 21	FIRE SUPPRESSION
211300	Fire Suppression Sprinkler System
DIVISION 22	PLUMBING
220500	Plumbing Materials and Methods
220700	Plumbing Insulation
221000	Plumbing Piping and Pumps
223000	Plumbing Equipment
224000	Plumbing Fixtures
DIVISION 23	MECHANICAL
230500	HVAC Materials and Methods
230590	Testing, Adjusting and Balancing
230700	HVAC Insulation
231000	Facility Fuel Gas Systems
233000	Air Distribution
233400	HVAC Fans
236000	Cooling - Air Cooled Heat Pump
237300	Fan Coil Units
237400	Packaged HVAC Units
238000	Terminal HVAC Equipment

## SECTION 211300 - FIRE SUPPRESSION SPRINKLER SYSTEM

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the plumbing work specified in this Division.
- B. The requirements of this section apply to the fire suppression system.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all design, labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes. Provide all labor and material and perform such other services necessary and reasonably incidental to the design and installation of an automatic sprinkler and standpipe system for all areas indicated on the Drawings and as required by the Governing Agency.

#### 1.2 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 1. Established fire protection contractor regularly engaged in the design and installation of automatic fire sprinkler systems.
  - 2. Employ workers experienced and skilled in this trade.
  - 3. System Designer: Qualified and certified for the design of fire protection sprinkler systems. NICET level III or IV technician or Professional Engineer experienced in the design of sprinkler systems.
- B. Governing Agency: All work in accordance with and accepted by the following hereafter referred to Governing Agencies:
  - 1. State of Oregon Fire Marshal.
  - 2. City of Portland, Oregon Fire Marshal.
- C. Design Requirements:
  - 1. Comply with the latest issue of NFPA Standard 13.
  - 2. Design, lay out and install hydraulically calculated wet and dry pipe systems, including standpipes, utilizing code approved automatic devices designed particularly for use in this type of system.
  - 3. Provide hydraulic calculation methods design data information in accordance with NFPA 13. Include all friction losses from point of flow test to remote sprinkler area.
  - 4. Fire Sprinkler Coverage: As required by the Governing Agency and including fire protection of all areas including the following:
    - a. Exterior canopies of combustible construction.
    - b. Covered decks and patios.
    - c. Covered parking areas.

- d. Attic spaces of combustible construction.
- e. Window wash sprinklers at exposures.
- f. See fire protection plans for additional requirements.
- 5. Occupancy Hazard: Occupancy Hazard designation in accordance with the Governing Agency requirements.
- 6. Seismic Restraint: Include load calculations for seismic restraints.
- 7. Contractor shall review all drawings and determine where unheated spaces, concealed combustible spaces, overhead doors, or similar special conditions exist and provide sprinkler protection as required.
- 8. Revisions to the Contractor's design required by the Governing Agency shall be at the Contractor's expense.
- D. Acceptable Manufacturers: All sprinkler specialty material by Reliable, Globe, Tyco, Viking, Automatic Sprinkler Corp. of America with UL or FM approval for use in automatic sprinkler systems. All materials and equipment suitable for 175 psi working pressure.
- E. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.

### 1.3 WORK OF OTHER CONTRACTS

- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.

### 1.4 WORK OF OTHER DIVISIONS

- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.

### 1.5 SUBMITTALS

- A. Working Drawings:
  - 1. Prepare fire protection system working drawing showing locations and types of heads or outlets, alarm valves and devices, pipe sizes and cutting lengths, test tees and valves, drain valves, and other related items. Include pipe nodes and remote areas referenced in the calculations. Plans shall be stamped and signed by the responsible certified designer. Plans shall be completed using CAD.
  - 2. Prepare drawings identifying and detailing all penetrations of structural elements. All such penetrations shall be reviewed and approved by the structural engineer prior to proceeding with installation drawings.

3. Provide 3 sets of drawings showing sprinkler head locations and layout coordinated with architectural ceiling details to the Architect for review prior to submitting details to the Governing Agencies.
4. Provide 6 sets of drawings to the Architect to be provided to Insurance Underwriter for approval.
5. Provide 6 sets of drawings to designated representatives of the Fire Marshal for approval.
6. Then provide 6 sets of approved Drawings to the Architect for final review.

B. Submittals: Provide submittals for the following products.

1. Sprinkler Heads: Product Data for each type of head.
2. Alarm flow or pressure switches.
3. Fire department connection.
4. System control valves and trim.
5. Piping supports and braces.
6. Piping materials.
7. Alarm bell.
8. Standpipe components.
9. Air compressor or air maintenance device.
10. Miscellaneous Equipment.
11. Double detector check backflow preventer with remote reader.

C. Test Reports: Submit certificates of completion of tests and inspections.

1.6 EXTRA STOCK

- A. Additional Heads: Provide number, type and temperature rating installed as required to meet NFPA 13 requirements.
- B. Storage Cabinet: Provide as required to receive reserve sprinkler heads and special installation tools required.
- C. Index Label: Provide for each head indicating manufacturer, model, orifice, size or K-factor, and temperature rating. Also provide inside cabinet a list of heads stored within and brief description of where installed.

1.7 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.
- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. Miscellaneous Sprinkler Specialties: Complete system including all items required by the Governing Agency including but not limited to:
1. Electric alarm switch and indoor and outdoor alarm bell or horn/strobe.
  2. Valve monitoring switches with two outputs (one to fire alarm & one to sprinkler bell).
  3. Wiring from the alarm switches to the point of connection in the Fire Alarm Control Panel. Coordinate with the Electrical Work specified in Division 28.
- B. Sprinkler Heads: Approved heads with temperature ratings required for service indicated.
1. Unfinished Areas: Upright, pendant or sidewall spray type, plain bronze.
  2. Finished Areas: White flush concealed ceiling and sidewall heads in finished ceilings, walls, and soffits with white escutcheons. Where piping is exposed use chrome plated upright heads.
  3. Dry pendant or dry sidewall heads for small areas subject to freezing and for pendant heads on dry pipe systems.
  4. Exterior Areas: Bronze heads, field paint escutcheons at exterior locations to match adjacent surfaces.
- C. System Piping:
1. Underground Water Piping: Ductile cast iron water pipe; ANSI A-21.51; with mechanical joints, ANSI A-21.10 and ANSI A21.11; and with concrete thrust blocks as detailed on the Drawings.
  2. At contractor's option, one piece type 304 stainless steel, factory fabricated and tested sprinkler riser may be used.
  3. Above Ground Water Piping: Use standard weight (schedule 40) black steel pipe ASTM A53, A135, or A795, and cast iron screwed or mechanical joint fittings especially adapted and approved for sprinkler work. Use reducing fittings where changes in pipe size occur. Bushings are prohibited. Provide galvanized pipe for dry systems.
  4. At Contractor's option, Schedule 10 black steel pipe ASTM A135 or ASTM A795, and mechanical joint fittings specifically approved for sprinkler use, may be substituted for the black steel pipe specified above. Pipe shall be UL listed and FM approved for 300 psi working pressure. Pipe must have a CRR of 1.00 or greater. Provide galvanized pipe for dry systems.
  5. At contractor's option, in accordance with code and upon approval of the authority having jurisdiction, approved plastic fire sprinkler piping materials may be used.
  6. At contractor's option, flexible sprinkler head drops may be used in lieu of rigid piping. Hose assembly shall be UL listed and FM approved. Ceiling attachment bracket shall be seismically certified. Hose assembly constructed of fully welded corrugated stainless steel hose with stainless steel overbraid with threaded stainless steel pipe fittings. No gaskets, O-rings, flares, or similar mechanical joints permitted.
- D. Pipe Escutcheons: Provide polished chrome escutcheons on pipe extending through finished walls and ceilings, oversized to meet seismic requirements.

- E. Valves: UL and/or FM listed for fire protection service.
  - 1. Iron body OS&Y pattern, bronze mounted double disc, parallel seat.
  - 2. Iron body butterfly style with EPDM liner, bronze disc with indicating type gear operator.
  - 3. Bronze body ball valve, three-piece design, with approved operator.
  - 4. Where required by Governing Agency, provide wall or post style indicating valves.
  - 5. Standpipe Valves: Angle or straight pattern rough chrome gate valve with cap and retaining chain.
- F. Valve Monitoring Switches: Provide approved monitoring switches where required by Governing Agency. In vaults and other areas where flooding conditions may occur, provide submersible type switches.
- G. Sprinkler Guards: Standard manufacture.
- H. Floor Control Station: Assembly consisting of shutoff valve with tamper switch, flow switch, test valve and drain valve.
- I. Water Service Connection Backflow Preventer:
  - 1. Connect to fire water service with code approved double check valve assembly made up of two internally spring loaded check valves, indicating monitored shut-off valves and test cocks.
  - 2. When required by serving utility, include a smaller bypass double check assembly and meter with remoter readout.
- J. Dry Pipe Sprinkler Valve: Externally resettable valve with high and low air pressure monitoring switches, pressure alarm switch, and required test and operation trim. Provide with air maintenance device where connected to plant air.
- K. Dry pipe Air Compressor: Air compressor shall be specifically designed for fire sprinkler service. Tank mounted compressors shall include mounting feet for attachment to the floor, receiver drain and relief valves, and pressure gauge. Compressor shall be belt or direct drive and include pressure switch.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Connect to water supply source as shown on Drawings, check adequacy, and call any deficiency to attention of Architect. Verify underground piping has been flushed. Coordinate with work in Division 22 and 33.
- B. Install all piping in a true and even manner with lines pitched for drainage and system arranged so that it can be entirely emptied of water. Install hangers at all branch line connections to cross mains and at all other points as required in NFPA standards.
- C. Support all pipe work from building construction with mild steel hangers spaced not more than

12 feet on centers. Support mains independently of branches, and in no case shall branch hangers assume any portion of the weight of mains. Do not bend hanger rods. Provide seismic restraints and flexible connections in accordance with building code requirements.

- D. Do not drill or punch flanges of beams, purlins, joists, etc. for hangar attachment without written permission from the structural engineer. Coordinate with the structural engineer for written criteria for drilling of holes in joists and beams for passage of sprinkler piping.
- E. Locate sprinkler heads in repeating, modular pattern, centered and accurately coordinated with ceiling grid as indicated. Conceal all piping unless indicated otherwise. Coordinate design with lighting and exposed HVAC duct layout in areas without ceilings.
- F. Maintain clearances between sprinkler heads and ceiling mounted items such as light fixtures. Use of pendant sprinklers to reduce clearances will not be permitted.
- G. Flexible sprinkler head drops, including attachment brackets, shall be installed in accordance with the manufacturer's instructions and approvals.
- H. Locate and install the required fire sprinkler alarm flow switch, relief valve, and test and drain valves where required by the Governing Agency. Identify valves with approved permanent placard.
- I. Provide a listed, supervised shutoff valve and a pressure gauge in each riser. A backflow preventer assembly may serve as the shutoff valve when located in the riser room. Mount hydraulic calculation placard in visible location on each riser.
- J. Securely anchor the air compressor in place and connect to the dry pipe valve with rigid piping and a braided/corrugated flexible stainless steel connector.

### 3.2 TEST

- A. Test all pipes to a hydrostatic pressure of 200 psi and maintain for four hours minimum. Perform other tests as directed by Governing Agency.

### 3.3 PAINT

- A. All exposed piping and hangers shall be painted under Division 9.
- B. Do not paint sprinklers.

### 3.4 CERTIFICATE OF COMPLETION

- A. Obtain and deliver to Owner a certificate, in duplicate, stating that system as installed has been inspected and accepted by authorities and/or agencies having jurisdiction, and that all regulations affecting work have been satisfied. Submit an acceptable certificate to the Owner before final payment is requested.
- B. Certificate: Minimum NFPA Figure 24.1 information per NFPA 13.

END OF SECTION 211300

## SECTION 220500 - PLUMBING MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the plumbing work specified in this Division.
- B. The requirements of this Section apply to the plumbing systems specified in these Specifications and in other Division 22 sections.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes.
- D. The work shall include, but not be limited to, the following systems:
  - 1. Water and sanitary sewer service complete per serving utility company requirements.
  - 2. Service and distribution piping including valves, supports, insulation, etc.
  - 3. Complete plumbing systems, including fixtures, trim, equipment, etc.
  - 4. Rough-in and final connection of plumbing equipment and fixtures furnished under other Divisions of this Specification.
  - 5. Special systems as specified herein.
  - 6. Work provided and designed by the Design Build Contractor, based on the Design assist drawings and performance specifications.
- E. Advise subcontractor, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.

#### 1.2 QUALITY ASSURANCE

- A. All work and materials shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations. All clarifications and modifications which have been cleared with appropriate authorities are listed under the applicable sections. All electrical products shall bear the label of a recognized testing laboratory such as UL or CSA.
- B. Whenever the requirements of the Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. Codes and Standards: Comply with the provisions of the following referenced codes, standards and specifications:
  - 1. Federal Specifications (FS)
  - 2. American National Standards Institute (ANSI)
  - 3. National Electrical Manufacturer's Association (NEMA)
  - 4. National Fire Protection Association (NFPA)
  - 5. Underwriters Laboratories, Inc. (UL)



6. Factory Mutual (FM)
7. International Building Code (IBC) with State and Local Amendments
8. International Mechanical Code (IMC) with State and Local Amendments
9. Uniform Plumbing Code (UPC) with State and Local Amendments
10. American Society for Testing and Materials (ASTM)
11. Americans with Disabilities Act (ADA)
12. International Fire Code (IFC) with State and Local Amendments
13. Energy Policy Act (EPAAct)
14. Manufacturers Standardization Society (MSS)
15. National Sanitation Foundation (NSF)
16. American Gas Association (AGA)

- D. Each piece of equipment furnished shall meet all detailed requirements of the Drawings and Specifications and shall be suitable for the installation shown. Equipment not meeting all requirements will not be acceptable, even though specified by name. Where two or more units of the same class of equipment are furnished, use product of the same manufacturer; component parts of the entire system need not be products of same manufacturer. Furnish all materials and equipment, new and free from defect and of size, make, type and quality herein specified or approved by the Architect. All materials shall be installed in a neat and professional manner.
- E. All apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both.
- G. Drawings: Do not scale drawings for roughing-in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.
- H. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.

### 1.3 WORK OF OTHER CONTRACTS

- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.

### 1.4 WORK OF OTHER DIVISIONS

- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. HVAC piping systems, fuel piping systems, fire suppression piping systems, and control devices and control wiring relating to the heating and air conditioning systems are specified

under other Divisions of these Specifications except for provisions or items specifically noted on the Drawings or specified herein.

- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.
- D. All sections of Division 22 are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any section of Division 22. Individual sections are not written for specific subcontractors or suppliers but for the general contractor.

#### 1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES (SUBMITTALS)

- A. Submit in accordance with Division 1 full technical and descriptive shop drawing data on proposed materials and equipment as detailed in each section.
- B. The Contractor shall verify that all equipment submitted can be delivered and installed within the time constraints of the construction period.
- C. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, included options and accessories and description of physical appearance for each item submitted. Reproduction of catalog data sheets shall be clean and legible to show all details, including gauge of metal used.
- D. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with rubber stamp arrow or similar concise method.
- E. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- F. Include field wiring diagrams and connection diagrams for all control and/or low voltage systems, including floor plans.
- G. Submittal Review: The submittal review process is a means to provide quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders." Approval of the data for substitution and shop drawings shall not eliminate the contractor's responsibility for compliance with Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- H. Unless otherwise directed by Division 1, submittal data shall be in a 3-ring plastic binder with a clear plastic sleeve and a project identification sheet inserted. Arrange submittals numerically with specification sections identified on divider tabs. All required sections shall be submitted at one time.

## 1.6 PRODUCT SUBSTITUTION

- A. Materials other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.

## 1.7 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work.

## 1.8 RECORD DOCUMENTS

- A. Project Record (As-Installed) Drawings:
  - 1. Maintain a set of record drawings on the job site as directed in Division 1.
  - 2. Keep Drawings clean, undamaged, and up to date.
  - 3. Record and accurately indicate the following:
    - a. Depths, sizes, and locations of all buried and concealed piping and all cleanouts, whether concealed or exposed, dimensioned from permanent building features.
    - b. Locations of all valves.
    - c. Changes, additions, and revisions due to change orders, obstructions, etc. Eradicate extraneous information.
    - d. Locations of tracer wire terminal points.
    - e. Model numbers of installed equipment.
  - 4. Make Drawings available when requested by Architect for review.
  - 5. Submit as part of the required Project Closeout documents.
- B. Operating and Maintenance Manuals: Submit five (5) sets of Operating and Maintenance Instructions, including manufacturer's service data, wiring diagrams, and parts lists and vendors for all serviceable items of equipment, valve charts, balancing data, final control diagrams showing final set points, and any additional equipment added by change order, bound in three-ring, vinyl or canvas covered, loose-leaf binders organized with index and thumb-tab markers for each classification of equipment or data.

## 1.9 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.

- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of two years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Compatibility: Provide products which are compatible with other portions of the work and provide products with the proper or correct power and fuel-burning characteristics, and similar adaptations for the project.
- C. Efficiency: Service (Domestic) Water Heating Equipment shall comply with the State Energy code. Where equipment efficiencies are indicated, the use of alternate or substitute manufacturer's equipment with lower efficiencies is not permitted.
- D. Storage and Handling:
  - 1. Delivery: Deliver to project site with manufacturer's labels intact and legible.
  - 2. Handling: Avoid damage.
  - 3. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

### 2.2 VALVES

- A. General: Provide factory fabricated valves of the type, body material, temperature and pressure class, and service indicated. Bronze gate, globe and check valves shall comply with MSS-SP-80. Ball valves shall comply with MSS-SP-110. Iron gate and globe valves shall comply with MSS-SP-70. Iron check valves shall comply with MSS-SP-71. Butterfly valves shall comply with MSS-SP-67. Valve size same as connecting pipe size.
- B. Acceptable Manufacturers: Milwaukee, Crane, Grinnell, Nibco, Hammond, Stockham, Legend, Watts, FNW, and Walworth. NIBCO numbers are given except as noted. Where possible, provide valves from a single manufacturer.
- C. Valve styles: Domestic hot and cold water.
  - 1. Valves 3" and Smaller:
    - a. Ball: Two-piece, DZR brass body, full port, 600 psi WOG, Fig. T/S-585-70.
    - b. Check: Bronze body, swing check, 200 psi WOG, T/S-413B (bronze disc) or T/S-413Y (Teflon disc).
  - 2. Valves 3" through 12":
    - a. Ball: Three-piece, bronze body, full port, 600 psi WOG, T/S-595Y.
    - b. Gate (to 3"): Bronze body, non-rising stem, 200 psi WOG, T/S-133.
    - c. Gate (4" to 12"): Iron body, bronze trim, non-rising stem, solid wedge, bolted

bonnet, 200 psi WOG, F-619.

- D. Selection of Valve Ends (Pipe Connections): Select and install valves with ends matching the types of pipe/tube connections.

### 2.3 HANGERS AND SUPPORTS

- A. General: Provide factory-fabricated horizontal piping hangers, clamps, hanger rod, inserts, supports, etc., of the recommended MSS type and size. The Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry Practice SP-58 and SP-69 are referenced in this section.
- B. Manufacturers: B-Line, Carpenter & Paterson, Grinnell, Michigan, Superstrut, Tolco, Erico, or accepted substitute. Grinnell figure numbers in parentheses where applicable (or other manufacturers as noted).
- C. Corrosion Protection: Provide materials which are zinc plated or factory painted to prevent corrosion. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.

### 2.4 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. 3M, Metacaulk, SpecSeal, or approved.
- B. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

## PART 3 - EXECUTION

### 3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, roughing-in dimensions and equipment locations before proceeding with any of the work.
- B. Sleeves, Inserts, Cast-in-Place Work: Provide sleeves, inserts, anchoring devices, cast-in-place work, etc. which must be set in concrete sequenced at the proper time for the project schedule.
- C. Coordination:
  - 1. The drawings are based on equipment of a certain manufacturer and may be identified as such. Where alternate manufacturers or approved substitutes are incorporated into the work, any required design changes are the responsibility of the contractor. Such changes may include changes in utility or system connection sizes, location, or orientation, service clearances, structural support or acoustic considerations.
  - 2. Where the work must be sequenced and positioned with precision in order to fit into the available space, prepare accurate scale shop drawings showing the actual physical

- dimensions required for the installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.
3. Cooperate with other trades in furnishing material and information for sleeves, bucks, chases, mountings, backing, foundations and wiring required for installation of mechanical items.
  4. Coordinate all work with other trades and determine in advance where interfacing of the mechanical work and other work are required to be connected together. Provide all materials and equipment to make those connections. Submit shop drawings showing required connections where special conditions exist.
- D. Discrepancies: Report immediately any error, conflict or discrepancy in Plans, Specifications and/or existing conditions. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping be necessary, provide for approval the simplest layout possible for that particular portion of the work.

### 3.2 UTILITY COORDINATION

- A. Utility Coordination: Coordinate all aspects of the incoming plumbing utility services indicated with the city engineer, serving utility, and the off-street improvements contractor. Requirements of the utility company which exceed the provisions made on the Drawings or covered by these Specifications shall take precedence. Provisions made on the Drawings or Specifications in excess of the utility company's requirements shall take precedence. No additional compensation will be allowed the contractor for connection fees or additional work or equipment not covered in the Drawings or Specifications which are a result of policies of the serving utilities.

### 3.3 MECHANICAL EQUIPMENT WIRING

- A. Provide all mechanical equipment motors, automatic temperature, limit, float and similar control devices required, with wiring complete from power source indicated on Electrical Drawings.
- B. Provide properly rated motor overload and undervoltage protection and all manual or automatic motor operating devices for all mechanical equipment.
- C. Equipment and systems shown on the Drawings and/or specified, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system including controls for the actual selected equipment/system.

### 3.4 GENERAL INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes, Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment and comply with Code requirements.
- B. Arrangement: Arrange rigid piping parallel with primary lines of the building construction, and with a minimum of 7' overhead clearance in all areas where possible. Unless indicated

otherwise, conceal all piping. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance. Give right-of-way to piping which must slope for drainage. Set all equipment level or as recommended by manufacturer. Under no conditions shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.

- C. Drip Pans: Provide drip pans under all domestic hot water heaters and washing machines (see contractor options below). Provide 3/4" drainage piping (1-1/4" for washer drain pan), properly discharged to over floor drain, to building waste system or as shown on the Drawings. Contractor options:
1. Provide washer drain pan, with direct 1-1/4" drain to waste system (trapped and primed).
  2. Provide washer drain pan, with moisture sensor to close electrically operated solenoid valves on the water supply lines.
- D. Access Panels: Provide access panels with proper backing reinforcement for all equipment, dielectric unions, valves and items requiring service and installed above ceilings, behind walls, or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels are not necessarily shown on Drawings. Use no panel smaller than 12" by 12" for simple manual access or smaller than 16" x 20" where personnel must pass through.
- E. Adjusting: Adjust and calibrate all automatic mechanical equipment, mixing valves, flush valves, float devices, etc. Adjust flow rates at each piece of equipment or fixture.
- F. Building Vapor Barrier: Wherever the building insulation vapor barrier is penetrated by piping, hangers, conduits, etc., provide clear self-adhesive tape recommended by the insulation manufacturer around the penetrations.

### 3.5 VALVE INSTALLATION

- A. General: Comply with the following requirements:
1. Install valves where required for proper operation of piping and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping, and where shown on the drawings. Install valves at low points in piping systems that must be drained for service or freeze protection.
  2. Locate valves in accessible spaces (or behind access panels) and so that separate support can be provided when necessary.
  3. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- B. Valve Access: Provide access panels to all valves installed behind walls, in furring or otherwise inaccessible.

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Proceed with the installation of hangers, supports and anchors only after the required building structural work has been completed in areas where the work is to be installed. Correct

inadequacies including (but not limited to) the proper placement of inserts, anchors and other building structural attachments.

1. Install hangers, supports, clamps, and attachments to support piping and equipment properly from the building structure. Use no wire or perforated metal strap to support piping, and no supports from other piping or equipment. For exposed continuous pipe runs, install hangers and supports of the same type and style as installed for adjacent similar piping.
2. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated or by other recognized industry methods.
3. Support piping independently of fire sprinkler piping.
4. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at panel points only.

B. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
2. Install hangers and supports so that equipment and piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Install hangers and supports to provide the indicated pipe slopes.

C. Pipe Support:

1. Vertical Spacing: Support at base, at equivalent of every floor height (maximum 10' as required by Code) and just below roof line.
2. Screwed or Welded Steel or Copper Piping: Maximum hanger spacing shall be as follows:

	<u>Steel</u>	<u>Copper</u>
1-1/4" and smaller	7' span	6' span
1-1/2" pipe	9' span	6' span
2" pipe	10' span	10' span
2-1/2" & larger	12' span	10' span

3. PVC, ABS and Other Rigid Plastic Pipe: Maximum hanger spacing and minimum rod diameters as follows:
  - a. Continuous support 1/2" to 4" pipe size Fee & Mason No. 109 channels with Fee & Mason No. 108 hanger. Lay pipe directly into the channel with fittings or couplings placed in spaces between channel sections. Secure piping to the channel at intervals between hangers with a few turns of vinyl electrical tape.
  - b. Non-Continuous Support: Maximum 4' spans or shorter if required by manufacturer for temperatures and pipe schedule.
  - c. Arrange supports to allow free movement, but restrict upward movement of lateral runs so as not to create reverse grade on drainage pipe. Use double bolt clamp or band hanger with restraint (Tolco fig. 25).
4. PEX and Other Flexible Plastic Pipe:
  - a. Continuous support: Channel support system as specified above or in exposed locations may be supported within EMT tubing supported as specified for steel pipe.



- b. Non-continuous support: Maximum 32” spans in concealed locations.
- 5. Install additional hangers or supports at concentrated loads such as pumps, valves, etc. to maintain alignment and prevent sagging.
- 6. Support Rod: Hanger support rods sized as follows:

<u>Pipe and Tube Size</u>		<u>Rod Size</u>	
<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>
1/2” to 4”	12.7 to 101.6	3/8”	9.5
5” to 8”	127.0 to 203.2	1/2”	12.7
10” to 12”	254.0 to 304.8	5/8”	15.9

- D. Adjust hangers and supports to bring piping to proper levels and elevations.
- E. Provide all necessary structural attachments such as anchors, beam clamps, hanger flanges and brackets in accordance with MSS SP-69. Attachments to beams and joists wherever possible. Supports suspended from other piping, equipment, floor sheathing, etc., are not acceptable.
- F. Horizontal banks of piping may be supported on common steel channel member spaced not more than the shortest allowable span required on the individual pipe. Maintain piping at its relative lateral position using clamps or clips. Allow lines subject to thermal expansion to roll axially or slide. Size channel struts for piping weights.
- G. Installation of drilled-in concrete anchors shall comply with the manufacturer’s instructions for working load, depth of embedment, and spacing between anchors and from the edge of the slab. Use only wedge style anchors.

3.7 EQUIPMENT CONNECTIONS

- A. Provide complete plumbing connections for all items of equipment requiring such connections, including incidental piping, fittings, trim and labor necessary for a finished working installation.
- B. Verify the rough-in and finish requirements for all equipment provided under other Divisions of the work and requiring plumbing connections with equipment supplier and installer prior to rough-in. Minimum branch pipe size for fixtures shall be 1/2". Final piping connection to fixture stops shall be made using metal pipe or tube.

3.8 PROTECTION

- A. Protect all work and materials against loss or damage. Close all pipe openings with caps or plugs. At final completion, thoroughly clean and deliver all work and equipment in an unblemished new condition. Keep all motors and bearings in watertight and dustproof covers during entire course of installation.

3.9 PIPE PENETRATION FIRE STOPPING

- A. Install as recommended by manufacturer and in accordance with the product’s UL listing. Below are the minimum installation requirements.
  - 1. Install specified penetrating item(s) with required annular spacing in proper size wall or floor opening. Support penetrating item(s) adequately on both sides of construction.
  - 2. Clean all opening and penetrating item surfaces in penetration area to remove loose

- debris, dirt, oil, wax, grease, old caulking, etc.
3. If needed or required for gypsum or concrete block walls, install specified galvanized steel wire mesh or sleeve recessed and centered inside wall around penetrating item(s) so that it is snug against perimeter of opening.
  4. When required, install specified type and depth of backing material in annular space, recessed to required fill depth of fire stopping caulking.
  5. Gun, trowel, and/or pump fire stopping sealant to specified depth in annular space around penetrating item(s). Trowel sealant surfaces flush with wall or floor surfaces to a smooth, defect-free finish. Where required, apply specified size caulking bead around penetrating item(s) at zero annular contact areas and tool smooth.

### 3.10 PLUMBING WORK CLOSEOUT

- A. General: Refer to the Division 1 sections for general closeout requirements. Calibrate all equipment requiring same. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of leaks, obstructions, or contamination.
- B. Record Drawings: Submit record set of drawings as previously specified in this Section.
- C. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect present, and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work.
- D. Operating Instructions: Conduct a walk-through instruction seminar for the Owner's personnel who are to be involved in the continued operation and maintenance of plumbing equipment and systems. Provide written instructions outlining and explaining the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

END OF SECTION 220500

## SECTION 220700 - PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the insulation of plumbing systems specified elsewhere in these specifications.
- B. The requirements of Section 220500, Common Plumbing Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Minimum Insulation Thickness and Thermal Performance: Comply with the State of Oregon Energy Efficiency Code except where more stringent requirements are specified herein.
- B. Composite (Insulation, Jacket or Facing and Adhesives) Fire and Smoke Hazard Ratings: Not to exceed a flame spread of 25 or smoke development of 50 and containing less than 0.1% by weight deca-PDE fire retardant.
- C. Component Ratings of Accessories (Adhesives, Mastics, Cements, Tapes, Finishing Cloth for Fittings): Same as "B" requirements above and permanently treated. No water soluble treatments.

#### 1.3 SUBMITTALS

- A. Submit catalog data and performance characteristics for each product specified.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: In addition to the requirements specified in Section 220500, the following apply:
  - 1. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
  - 2. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation. Remove such insulation from project site.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Insulation Manufacturers: Johns Manville, Owens-Corning, Knauf, Certain Teed, Armstrong, Pabco, Imcoa or Nomaco. Johns Manville products are listed unless indicated otherwise.
- B. Adhesive Manufacturers: Foster, 3M, Insul-Coustic, Borden, Kingco or Armstrong.

## 2.2 PIPING INSULATION

- A. Interior and Exterior Piping Systems 32 to 180 Deg. F: Glass fiber preformed pipe insulation with a minimum K-value of 0.23 at 75 deg. F, a minimum density of 3.5 pounds per cubic foot within all-service vapor barrier jacket, vinyl or pre-sized finish and pressure sensitive seal containing less than 0.1% by weight deca-PDE fire retardant.
- B. Pipe Temperatures Minus 30 to 180 Deg. F: Flexible, preformed, pre-slit, self-sealing elastomeric pipe insulation up to 2-1/8" ID, thermal conductivity of 0.27 BTU/hr. sq. ft./in. at 75 deg. F and vapor transmission rating of 0.2 perms/inch. Armstrong "Armaflex 2000" or, in concealed locations, Imcoa or Nomaco also approved.

## 2.3 INSULATION ACCESSORIES

- A. Insulation Compounds and Materials: Provide rivets, staples, bands, tapes, adhesives, cements, coatings, sealers, welded studs, etc., as recommended by the manufacturer for the insulation and conditions specified. No staples allowed on cold water piping systems.
- B. PVC Protective Jacketing and Valve and Pipe Fitting Covers: Johns Manville Zeston 2000, Proto LoSmoke, or Ceel-Co Ceel-Tite 100 Series with pre-cut fitting fiberglass insulation or approved.
- C. Jacket Lap Sealing Adhesives: Foster Drion 85-75 contact cement or approved substitute.
- D. Saddles and Shields: Install to prevent crushing of insulation at support points.
  - 1. Protection Saddles: MSS Type 39.
  - 2. Protection Shields: MSS Type 40.
  - 3. Preinsulated Pipe Supports: Calcium silicate load bearing metal jacketed inserts. Pipe Shields Inc. or accepted substitute.
    - a. Pipe supported on rods - Models A1000, A2000, A3000, A4000.
    - b. Pipe supported on flat surfaces - Models A1000, A2000, A3000, A4000.
    - c. Pipe supported on pipe rolls - Models A3000, A4000, A5000,.
    - d. Vertical riser clamp – Models E1000, E1100, E1200.

## PART 3 - EXECUTION

### 3.1 PIPING INSULATION

- A. General: Do not insulate underground piping.
- B. At the contractor's option and in accordance with Part 2 of this section, elastomeric insulation may be installed on domestic water piping in thicknesses providing overall thermal resistance equivalent to the glass fiber insulation. Increased thickness is typically required. Installation shall comply with the manufacturer's recommendation with joints and seams completely sealed.
- C. Domestic Water Piping:
  - 1. Insulate with glass fiber pipe covering, 1/2" thick for 1" and larger cold water piping.

2. Insulate circulated hot water piping with 1" thickness for 1" and smaller hot water piping; 1-1/2" for 1-1/4" and larger hot water piping.
  3. Insulate hot water return piping same as hot water piping.
- D. Interior Rain Drains:
1. Concealed: Insulate with 1" thick one pound density glass fiber blanket and continuous vapor barrier jacket.
  2. Exposed: Insulate with 3.5 pound density glass fiber insulation with continuous vapor barrier jacket.
- E. Waste Lines: Insulate all pipe exposed to outside temperatures with 3/4" thick glass fiber pipe insulation with a vapor barrier jacket. Insulate over freeze protection heat trace where indicated.
- F. Pipe Fittings: Insulate and finish all fittings including valve bodies, bonnets, unions, flanges and expansion joints with precut fiberglass insulation and preformed PVC covers sealed to adjacent insulation jacket for continuous vapor barrier covering over all fittings.
- G. Piping Insulation Lap Seams and Butt Joints: Install insulation jacket in accordance with manufacturer's recommendation and without staples on cold water lines. Where jacket joint and lap seams have not adhered, remove affected section of insulation and reinstall or apply lap sealing adhesive in accordance with manufacturer's instructions.

END OF SECTION 220700

## SECTION 221000 - PLUMBING PIPING AND PUMPS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide pipe, pipe fittings, piping specialties, pumps and related items required for complete piping system.
- B. Related Work: The requirements of Section 220500, Common Plumbing Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. General: ASTM, and ANSI Standards are indicated. In addition, special standards are referenced where neither ASTM nor ANSI Standards are applicable.
- B. Labeling: All piping shall be continuously and legibly labeled on each length as required by codes and standards and including as a minimum, country of origin, manufacturer's identification marking, wall thickness designation, and applicable standards and approvals. Fittings shall be labeled as required by the referenced standard. Tubular fixture traps shall be stamped with manufacturer's mark and material thickness.
- C. Potable Water Valves: Potable water piping materials not limited to faucets, mixing valves, shutoff valves, or pressure reducing valves. Valves shall meet NSF Standard 61, Section 9, for drinking water faucets and shall be brass construction. Brass components which contact water within the faucet shall be from brass which contains no more than 3 percent lead by dry weight.
- D. Definitions: Where piping fluid is not indicated in the following paragraphs, provide similar piping materials for similar fluids (i.e., "make-up water" = "domestic water"; "wet stand pipe" = "fire sprinkler pipe"; "drainage piping" = "sanitary/storm sewer piping").
- E. Plumbing System Disinfection and Testing shall be performed by an experienced, qualified, chemical treatment agency. Mt. Hood Chemical, Chemcoa, or approved alternate.
- F. Installer certification: Where piping systems include proprietary components, systems, or methods (PEX, Propress, Victaulic, etc.) the installers shall be certified by the product manufacturer for the installation of the product to ensure the validity of the factory warranty. Include installer certification documents with the product material submittals.

#### 1.3 STORAGE AND HANDLING

- A. Provide factory-applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube. Protect flanges, valves, and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

#### 1.4 SUBMITTALS

- A. Submit catalog data for each product specified.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

#### A. Copper Pipe and Tube:

1. Application:
  - a. Domestic water
  - b. Priming lines
  - c. Condensate lines where heat traced.
2. Pipe: ASTM B88.
  - a. Above Ground Domestic Water: Type L hard temper copper with soldered joints.
  - b. Underground Domestic Water and Priming Lines: Type L soft annealed with no joints or type K hard tempered copper with silver soldered joints.
3. Fittings: Wrought copper solder-joint fittings, ANSI B16.22.

#### B. Cast Iron DWV Pipe:

1. Application: 1-1/2" and larger in all non-residential areas including below and through the fire rated PT slabs.
  - a. Sanitary waste
  - b. Plumbing vent
  - c. Rain drain
2. Pipe: Hubless cast iron soil pipe, CISPI 301-05/ASTM A 888-05.
3. Fittings: Hubless cast iron fittings: CISPI 301-05/ASTM A 888-05.
4. Couplings:
  - a. Light Duty: Standard couplings meeting CISPI 310/ASTM A 1277.
  - b. Heavy Duty: No-hub couplings meeting ASTM C 1540, and FM 1680. ASTM C 564 neoprene gasket, type 304 SS corrugated shield and type 304 SS clamping bands. Four bands on 1-1/2" thru 4" pipe and 6 bands on 5" thru 10" pipe.
5. Manufacturers: Cast iron pipe and fittings – AB&I, Charlotte Pipe, Tyler Pipe, or approved. All pipe shall be labeled by the manufacturer.

#### C. Plastic Pipe – Drain, Waste, Vent (DWV):

1. Application: All residential areas.
  - a. Sanitary waste
  - b. Plumbing vent
  - c. Rain drain
2. Pipe:
  - a. Acrylonitrile-butadiene-styrene (ABS) (ASTM D3965) plastic drain, waste and vent piping (ASTM F628) and fittings (ASTM D2661) (DWV).
  - b. Polyvinyl chloride (PVC) (ASTM D1784) plastic drain, waste and vent pipe (ASTM D2665 and D1785) and fittings (ASTM D2665) (DWV).
3. Fittings: Provide fittings of the type indicated, matching piping manufacture. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended for the service indicated by the piping manufacturer.

#### D. Plastic Pipe:

1. Application: Where approved by Code.
  - a. Domestic water, underground
  - b. Water heater & Washer pan drain
  - c. Condensate drains, non-heat traced.
2. Pipe:
  - a. Polyvinyl Chloride and Chlorinated Polyvinyl Chloride Plastic Pipe for Water Service: SDR-PR pipe, ASTM D2241; Schedules 40, 80 and 120, ASTM D1785.
3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended by the piping manufacturer for the service indicated.

E. Plastic Pipe:

1. Application: Allowed within residential units only. Not permitted in corridors, dwelling unit risers or at penetrations of rated walls.
  - a. Domestic water, 1" and smaller.
2. Pipe:
  - a. Cross-linked polyethylene (PEX) tubing for Water Service: ASTM F877; SDR 9. NSF-pw and NSF 61.
3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide fittings produced and recommended by the piping manufacturer for the service indicated.

## 2.2 MISCELLANEOUS PIPING MATERIALS

A. Soldering and Brazing Materials: Provide soldering materials as determined by the installer to comply with installation requirements.

1. Tin-Antimony Solder: ASTM B32, Grade 95TA.
2. Lead-Free Solder: ASTM B32, Grade HB. Harris "Bridgit" approved.
3. Silver Solder: ASTM B32, Grade 96.5TS.
4. Flux: Water soluble paste flux.
5. Brazing filler rod: BCuP rod to suit conditions.

B. Strainers: "Y-pattern," iron or bronze body rated for pressures indicated with blow-off connection and 20 mesh stainless steel screen.

C. Tracer Wire: 14 gauge, single strand, copper wire with blue insulation for water, green for sanitary and storm sewers, and yellow for gas. 3M "DBY" direct bury splice kit required at all splices.

D. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite "Hydroflame".

## 2.3 PIPING SPECIALTIES

A. Cleanouts: PVC bodies with nickel bronze adjustable top where located in finished or concrete floors.



- B. Floor Drains: PVC construction with anchor flange and stainless steel or nickel bronze top, and other options as indicated by model number. Cast iron drains and tops for heavy duty drains (Including all trash rooms).
- C. Roof drains: Cast iron body and dome with flashing clamp, sump receiver, and underdeck clamp. Drain configuration to match roofing system. Overflow drains with 2" high water dam.
- D. Roof drain outlet nozzle: Polished nickel bronze nozzle with trim ring and threaded or socket pipe connection.
- E. Priming Valves: Smith 2699, Josam 88250, Wade W8800T, Zurn Z1022, Watts MS810 or equivalent Precision Plumbing, Mifab. Locate in closets, under counters or in walls behind access panels as specified in Section 220500. Use copper specified previously for all underground priming lines.
- F. Traps: Except chrome plated fixture traps. Recessed drainage pattern for threaded pipe and same grade as pipe for plastic pipe; with cleanout plugs in trap body in all above grade locations.
- G. Pressure Reducing Valve: Single seat type with renewable stainless steel seat and valve. Size and capacity as shown on Drawings. Bronze bodies with screwed connections on valves 2-1/2" and smaller and flanged steel bodies on valves 3" and larger. Install each PRV with strainer on inlet or internal strainer. Leslie, Watts, Cash-Acme, Zurn-Wilkins, or approved substitute.
- H. Backflow Preventer: Where indicated on the Drawings, install a double check backflow preventer complete with shutoff valves, two separate check valves, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2" and smaller, and cast iron bodies with bronze trim on units 2-1/2" and larger.
- I. Backflow Preventer: Where indicated on the Drawings and all buildings with roof gardens, water features or living walls, install a reduced pressure backflow preventer complete with strainer on inlet, shutoff valves, two separate check valves, differential relief valve with drain funnel, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2" and smaller, cast iron bodies with bronze trim on units 2-1/2" and larger, and stainless steel construction for carbonated beverage service.
- J. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite "Hydroflame".
- K. Master Mixing Valve: All brass or bronze body with stainless steel parts, thermostatic master control element to fail safe upon cold water or control element failure meeting ASSE 1017. Provide with external union angle check stops, strainers, volume control, shutoff valves, dial thermometer. Valve location, arrangement and capacity as shown on plans. Leonard, Lawler, Powers, Acorn, Bradley, Symmons, or approved substitute. See section 3 for factory start-up procedures.

- L. Domestic Water Balancing Valve: Balancing fitting with differential pressure taps, brass or bronze body and trim. B&G "Circuit Setter" or equivalent Taco, Armstrong, Thrush, Wheatley, Flow Design or approved substitute. At contractor's option, balancing valves 3" and larger may be butterfly style, Jenkins No. 222 EL or approved substitute as specified in Section 221000.

#### 2.4 BACKFILL MATERIALS

- A. Subbase Materials: A graded mixture of gravel, sand, crushed stone or crushed slag.
- B. Finely-Graded Subbase Material: Well graded sand, gravel, crushed stone or crushed slag, with 100% passing a 3/8" sieve.
- C. Backfill Material: Soil material suitable for compacting to the required densities, and complying with AASHTO designation M145, Group A-1, A-2-4, A-2-5. or A-3.
- D. Elevator Sump Pump: Submersible, 100 gpm at 15 ft. head, 1-horsepower sump pump with integral float switch. Myers, Paco, Hydronix, Zoeller, Viking, Liberty, or approved.

### PART 3 - EXECUTION

#### 3.1 UTILITY SERVICE

- A. Plumbing Utility Connections: Complete installation. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.
- B. Sanitary and Storm Sewers: Connect to or arrange for connection to sanitary and storm sewers as shown on the Drawings and as required by the serving utility. Verify depth, size and location prior to installation of the new sewer systems.
- C. Water Service: Connect to or arrange for connection to water service as shown on the drawings. Verify serving utility requirements prior to beginning any installation. Verify water main size, depth, pressure and location prior to starting work.
- D. Fire Service: Connect to or arrange for connection to fire water service as shown on the drawings. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.

#### 3.2 PIPE INSTALLATION

- A. Comply with the following applicable HUD standards:
  - 1. HUD UM 76 CPVC & PB Hot and Cold Water Distributing Pipe.
  - 2. HUD UM 78 PE, ABS, PVC, & PB Plastic Piping for Domestic Water.
  - 3. HUD UM 79a ABS & PVC Plastic Pipe and Fittings for Drain, Waste, and Vent.
- B. General: Install pipe, tube and fittings in accordance with recognized industry practices and

plumbing code standards. Install each run accurately aligned with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings.

- C. Piping Runs: Route piping close to and parallel with walls, overhead construction, columns and other structural and permanent-enclosure elements of the building. Install piping plumb and level except where pitched for drainage. If not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building or equipment and avoid diagonal runs. Wherever possible in finished and occupied spaces, conceal piping from view. Do not encase horizontal runs in solid (concrete or CMU) partitions.
- D. Tracer Wire: Install tracer wire as close to underground non-metallic water, sanitary and storm sewers and gas pipe in the trench as possible. Tracer wire shall be accessible at grade via all services, valve and meter boxes, curb cocks, cleanouts at the building, manholes (inside the cover near the top), etc. Locate all points on the record as-installed drawings. Splice into utility tracer system where available. Comply with code requirements.

### 3.3 PIPING JOINTS

- A. General: Provide joints of the type indicated in each piping system, and where piping and joint as manufactured form a system, utilize only that manufacturer's material.
- B. Threaded Piping: Thread pipe in accordance with ASME B1.20.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave no more than three threads exposed.
- C. Solder Copper Tube and Fitting Joints: In accordance ANSI B 828 with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. "T-Drill" field formed tees with brazed joints may be utilized where the main is at least two pipe sizes larger than the branch.
- D. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:
  - 1. Heat Joining of Thermoplastic Pipe: ASTM D-2657.
  - 2. Making Solvent-Cemented Joints: ASTM D-2865 and ASTM F-402.
- E. Insulating (Dielectric) Fittings: Comply with manufacturer's instructions for installing unions or fittings. Install in a manner which will prevent galvanic action and stop corrosion where the "joining of ferrous and non-ferrous piping" is indicated.
- F. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.
- G. Line Grades:

1. Drainage Lines: Run at maximum possible grade and in no case less than 1/8" per foot within building.
2. Vents: Pitch for drainage 1/4" per 10'.
3. Water: Pitch to low points and install hose bib drains. 3' minimum depth of ground cover for all lines outside building unless otherwise noted.

- H. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
- I. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.

### 3.4 CLEANOUTS

- A. Where required by code, at each change of sewer direction 45 degrees or greater and more than 10' long, at end of each branch or main and spaced not greater than 100' apart, as required by code and/or as shown on Drawings.

### 3.5 MISCELLANEOUS PIPING EQUIPMENT

- A. Floor, Wall and Ceiling Plates: Chrome plated pressed steel or brass screw locked split plates on all pipe penetrations in finished spaces.
- B. Strainers: Install in a manner to permit access for cleaning and screen removal and with blow-off valve.
- C. Sleeves: At all cast in place penetrations of concrete or masonry construction. PVC, 24 gauge galvanized steel or Schedule 40 galvanized steel pipe. Use steel pipe sleeves through beams, footings, girders or columns and for all penetrations of walls or floors below grade. Where floor finish is ceramic tile, terrazzo, or similar material extend standard steel pipe sleeves 1-1/2" above finished floor. Fabricate sleeves 1" diameter larger than pipe or insulation. PVC and sheet metal sleeves at non-structural penetrations only.
- D. Sleeve Caulking: Caulk below grade pipe with rubber link seal. Grout above grade pipe with cement mortar or approved waterproof mastic. Install UL sealing caulk, putty and/or system at all penetrations of fire rated walls, floors and ceiling.
- E. Trap Priming: Traps serving floor drains, floor sinks, catch basins, and similar fixtures shall be primed in accordance with Code requirements.
- F. Heat Trace: Apply freeze protection heat trace to traps exposed to outdoor temperatures.
- G. Domestic Hot Water Mixing Valves: Install in accordance with manufacturers installation instructions and piping diagrams.

### 3.6 EXCAVATING

- A. General: Do not excavate for mechanical work until the work is ready to proceed without delay, to minimize the total time lapse from excavation to completion of backfilling. Comply

with all applicable Federal and state safety regulations and local erosion control requirements.

- B. Width: Excavate for piping with 6" to 9" clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Excavate for other work to provide minimum practical but adequate working clearances.
- C. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate the bottom cut to accurate elevations. Support the following work on undisturbed soil at the bottom of the excavations:
  - 1. Piping of 5" and less pipe/tube size.
  - 2. Cast-in-place concrete.
- D. Depth for Exterior Piping: Excavate for exterior water-bearing piping (water and drainage) so that the top of piping will not be less than 2' vertical distance below finished grade.
- E. Depth for Unsatisfactory Soil Conditions: Where unsatisfactory soil condition at the bottom of excavation exists, excavate additional depth as directed to reach satisfactory soil-bearing condition. Backfill with subbase material, compacted as directed, to indicated excavation depth.
- F. Excavated Materials: Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work. Do not store under trees (within the drip line). Retain excavated material which complies with the requirements for backfill material. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

### 3.7 BACKFILLING

- A. Do not backfill until installed mechanical work has been tested and accepted wherever testing is indicated. Install drainage fill where indicated, and tamp to a uniform firm density. Backfill with finely-graded subbase material to 6" above wrapped, coated and plastic piping. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen materials.

### 3.8 CLEANING

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary. Removed labels and tags from plumbing fixtures and trim.
- B. Disinfection of Domestic Water Piping System:
  - 1. Piping system disinfection shall be performed by an approved agency. The following procedure may be modified upon their recommendation and Engineers approval.
  - 2. Prior to starting work, verify system is complete and clean.
  - 3. Open all drains and fixtures valves in the building starting with the valve nearest the water service line and permit the water to run clear for 10 minutes to eliminate grease, cuttings, flux, and foreign matter.
  - 4. Inject disinfectant at beginning of water system to be disinfected. Introduce free chlorine

in liquid form, throughout system to obtain concentration required by local Public Health Department regulations or 50 to 80 mg/L residual.

5. Bleed water from all potable water outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
6. Maintain disinfectant in system for 24 hours.
7. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
8. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.
9. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601. If any sample fails the analysis, repeat the procedure.
10. Include a copy of the bacteriological analysis in the Operating and Maintenance manuals.

C. Sanitary and Storm Drainage System:

1. Remove construction debris from cleanouts, drains, strainers, baskets, traps, etc., and leave same accessible and operable. Place plugs in the end of uncompleted piping at the end of the day or whenever work stops.
2. Before final acceptance of completed sewer system, flush and clean the entire system with water. Trap and remove solid material obtained from flushing and cleaning from the new system. Do not allow debris to enter the existing sewer system.

3.9 TEST

A. General:

1. Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.
2. Provide all necessary temporary equipment for testing, including pump and gauges. Remove control devices before testing and do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for the indicated pressure and time.
3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

B. Repair

1. Repair piping system sections which fail the required piping test by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemical stop-leak compounds, solder, mastics, or other temporary repair methods.
2. Drain test water from piping systems after testing and repair work has been completed.

C. Sewer: Furnish all facilities and personnel for conducting the test. Test in accordance with the requirements of the State Plumbing Inspector and local authorities.

D. Plumbing Waste and Vent Piping: Hydrostatic test by filling to highest point, but not less than 10' water column on major horizontal portion.

E. Water Piping: Hydrostatic pressure of 100 psig without loss for four hours.

3.10 SUPERVISION AND START-UP

A. Adjust flush valves, pressure reducing valves, mixing valves, water heater thermostats, and similar equipment.

B. Master mixing valve start-up procedure: Provide a factory authorized representative to review the installation of the mixing valve and verify that the adjustment has been completed by an authorized agent of the manufacture. Provide documentation in the O&M documents showing adjustment has been completed per manufacture instructions. Record supply and return temperatures. Work shall be completed prior to substantial completion.

END OF SECTION 221000

## SECTION 223000 - PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the plumbing equipment.
- B. Provide plumbing equipment specified and shown on the Drawings.
- C. Related Work: The requirements of Section 220500, Common Plumbing Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Code: Comply with requirements of the Oregon State Plumbing Specialty Code.
- B. All equipment and component parts shall conform to governing codes.
- C. Labeling: All equipment shall have permanent labels affixed by the manufacturer listing model number, capacity, efficiency, approvals, and similar characteristics of the product.

### PART 2 - PRODUCTS

#### 2.1 PIPING

- A. Piping, fittings, pumps, and related items are specified in Section 221000.

#### 2.2 COMMERCIAL HIGH EFFICIENCY GAS-FIRED CONDENSING WATER HEATER

- A. AGA and serving utility approved commercial gas-fired condensing heater complying with the state energy code and ASHRAE 90.1-1999 requirements and of size and capacity shown on Drawings. Minimum water heater efficiency of 90%. Induced draft fan combustion system suitable for venting with plastic vent pipe. Glass-lined steel tank equipped with electronic anode and heat traps. 1-1/2" minimum of non-organic insulation, cold rolled enameled steel jacket to encase sides, top, and combustion chamber. Electronic controller with diagnostics and LED fault display, hot surface igniter, main and pilot gas cocks, automatic gas pressure regulator, all brass hose bib drain, and hand hole cleanout. ASME code pressure-temperature relief valve.
- B. A.O. Smith, Bradford White, Bock, or approved substitute.

#### 2.3 WATER HEATER ACCESSORIES

- A. Water Heater and Tank Seismic Restraints: For water heaters and tanks, Spacemaker, Holdrite "Quickstrap," or approved.
- B. Domestic Water Expansion Tank: Plastic lined drawn steel tank for potable water with epoxy exterior finish, air charging valve and system piping connection. Butyl rubber diaphragm with



steel retaining ring. Provide with relief valve where working pressure rating is less than 150 psi.

- C. Water Heater drain pan: Fabricated metal drain pan with reinforced rim and outlet connection.
- D. Water heater vent: Provide venting materials complying with water heater manufacturers installation requirements .Use CPVC where plastic pipe is allowed.

### PART 3 - EXECUTION

#### 3.1 UTILITY SERVICE

- A. Plumbing Utility Connections: Complete installation. Verify rough in dimensions of equipment prior to installing piping.

#### 3.2 EQUIPMENT INSTALLATION AND CONNECTION

- A. All equipment shall be installed plumb and level unless otherwise recommended by the manufacturer.
- B. Arrange piping connections to equipment to allow removal and replacement of the equipment without disassembly of connecting piping. Provide valves, unions, flanges, etc. at connection points.
- C. Arrange equipment for adequate service access as recommended by the manufacturer and as required by code.
- D. Anchor equipment to resist displacement due to seismic events as detailed on the drawings, recommended by the manufacturer, and as required by code and as specified in other sections of these specifications. Provide seismic straps as specified above for tank type water heaters.
- E. Drip Pans: Provide drip pans under all domestic hot water heaters. Provide 3/4" drainage piping, properly discharged to over floor drain, other approved receptor, or as shown on the Drawings.

#### 3.3 EQUIPMENT CLEANING

- A. Remove construction and shipping protection and thoroughly clean all plumbing equipment just prior to building acceptance.

#### 3.4 SUPERVISION AND START-UP

- A. Do not place equipment onto operation until required work of other trades is complete, e.g. venting systems, combustion air ducts, etc.
- B. Follow manufacturer's instructions for start-up and adjustment of equipment.

END OF SECTION 223000

## SECTION 224000 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the plumbing fixtures and trim.
- B. Provide fixtures as shown on the Drawings and specified herein. Provide all required fixture trim and accessories for a complete, finished installation.
- C. Related Work: The requirements of Section 220500, Common Plumbing Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Code: Comply with requirements of the Oregon State Plumbing Specialty Code.
- B. Fixture color: White unless indicated otherwise.
- C. Fixture Samples: Provide actual samples of plumbing fixtures and faucets prior to or included with the submittal package. Approved samples may be incorporated into the project.
- D. Potable Water Valves: Potable water valves not limited to faucets, mixing valves, or pressure reducing valves. Valves shall meet NSF Standard 61, Section 9, for drinking water faucets and shall be brass construction. Brass components which contact water within the faucet shall be from brass which contains no more than 3 percent lead by dry weight.

### PART 2 - PRODUCTS

#### 2.1 PIPING

- A. Piping, fittings, and related items as specified in related Sections 221000.

#### 2.2 PLUMBING FIXTURES AND TRIM

- A. Stops: Furnish stop valves for all fixtures. Wheel handle style, in wall, angle or straight through pattern to fit installation. Stops to be all brass with full turn brass stem and replaceable washer, no plastic. Compression nuts to be high copper content brass. Finish to be copper nickel chrome plate where concealed. Finish on exposed stops as noted. Product to carry manufacturer's name. Provide chrome plated shallow escutcheons. McGuire, Chicago, Brasskraft, Keeney, Zurn, or approved substitute.
- B. Fixture Traps: Exposed fixture tailpieces, traps, and wastes shall be chrome plated 17 gauge seamless brass tube with deep or box style escutcheons as required to conceal rough piping. Products to be stamped with manufacturer's name and material gauge. McGuire, Keeney, Zurn, or approved. Concealed fixture traps may be rigid plastic.

- C. Provide handicap piping protector kit on all exposed accessible fixture traps and supplies (I&S Insulation Co. Inc., Brocar Products Inc. kit 500R, McGuire "Prowrap," Plumberex "Pro-2000" or approved substitute.
- D. 1.28 Gallon, Water Closet, Elongated Type, Vitreous China: Floor mounted two piece close coupled, gravity tank type water closet shall be specifically designed for 1.28 gallon siphon jet flush. Minimum MaP score of 1000. Provide satin nickel finish stop, escutcheon, and flush lever.
1. Seat: White molded wood seat, with bumpers; closed front with cover to match bowl. Bemis 400.00. Church, Olsonite approved.
  2. Residential units "WC-1": Floor mounted, standard height. Toto CST744EN or approved American Standard, Kohler, or approved alternate
  3. Residential ADA units "WC-2": Same as above except ADA height fixture. Toto CST744ELN, or approved American Standard, Kohler, or approved alternate.
- E. 1.28 Gallon, Water Closet, Tank Type, Vitreous China: Water closet shall be specifically designed for 1.28 gallon siphon jet flush.
1. Seat: Solid white heavy weight molded plastic seat, with molded-in bumpers; open front less cover for elongated bowl with check and self-sustaining hinge. Hinge and hardware to be 300 series stainless steel. Church 295-SSC, Beneke 523-SS/CH-B, Bemis 1955 SS/C, or Zurn Z5956SS-EL-STS.
  2. Floor Mounted "WC-3": Toto CST 704, or approved American Standard, Kohler K-3432, or approved alternate.
- F. Residential Units Lavatory :
1. Faucet: Chrome single handle washerless cartridge 4" centerset body with matching pop-up drain. 0.50 gpm flow rate. Symmons S-9610-0.5.
  2. "LV-1" & "LV-2" Counter Mounted, Self-rimming, 19" round china with front overflow. Toto LT512.4 or American Standard, Kohler, or approved alternate.
- G. Public Lavatory LV-3:
1. Faucet: Chrome single handle washerless cartridge 4" centerset body with matching pop-up drain. 0.50 gpm flow rate. Symmons S-9610-0.5.
  2. Counter Mounted, Self-rimming, 19" round china with front overflow: Toto LT512.4 or American Standard, Kohler, or approved alternate.
- H. Stainless Steel Kitchen Sink:
1. 18 gauge, self-rimming stainless steel sink, bowl fully undercoated, with satin finish. Install with crumb cup strainer outlet, flange tail piece, and 1-1/2" trap.
  2. Residential Kitchen Double Sink "S-1": Elkay LRQ3319. Install with Delta 2400 with sprayer and lever handles (H28), and 1.5 GPM aerator.
  3. Residential Kitchen Double Sink, ADA "S-2". Elkay LRADQ331955. Install with Delta 2400 with sprayer and lever handles (H28.), and 1.5 GPM aerator.

- I. Recessed Clothes Washer Fitting: Hot and cold water valve washing machine waste outlet with quarter turn ball valves and water hammer arresters. Sioux Chief Ox Box. Fire rated where required. With secondary drainage funnel for HVAC unit drainage where required.
- J. Tub Shower"TS-1" : Install with chrome finish water saving shower head, arm, and flange, tub spout with diverter, and drain and overflow fitting. Lever handle, pressure equalizing mixing valve with temperature limit stop, and chrome finish. Delta T13H, or approved Chicago, Moen or alternate equal. Shower flow rate to be 1.5 gpm. 32" x 60" one-piece tub and shower with chrome drain and overflow, fully backed and reinforced for future grab bars. DCS-PNW XS100LSHAC.
- K. Tub Shower, ADA "TS-2": Same as "TS-1", except with 1.75 gpm max handheld showerhead and flex hose, vacuum breaker, grab bars & removable seat.
- L. Service Sump (Mop Basin)"SS-1":
  - 1. Faucet exposed, brass body, rough plated, long spout, top brace, hose end spout with bucket hook, vacuum breaker and integral stops in shanks. Chicago 897, T & S B-0665-BSTP, or equal Zurn, Delta Commercial, mounted 24" above rim. Install with 18 gauge type 302, No. 4 finish stainless steel splash on the two walls.
  - 2. Molded stone 24" x 36" x 10" deep with vinyl bumper guard and 3" brass body strainer outlet. Fiat, Mustee, Swan or approved substitute.
- M. Hose Bibs:
  - 1. "HB-2": Exterior non-freeze hot and cold mixing self-draining type with vacuum breaker, removable handle, brass wall casing and wall clamp. Woodford HC67.
  - 2. "HB-1": Exterior non-freeze self-draining type with vacuum breaker, removable wheel handle, brass wall casing and wall clamp. Woodford 65.
- N. Rood rains:
  - 1. "RD-1&OD-1": Combination Roof Drain/Overflow Drains. Zurn 164, or equal JR Smith, Sioux Chief. See plan for size.

## PART 3 - EXECUTION

### 3.1 PIPING

- A. Install in accordance with Section 221000.
- B. Hot and cold water stubouts to fixtures shall be copper. Secure stubouts with manufactured bracket system. Hubbard "Holdrite", Sioux chief, or approved.

### 3.2 FIXTURE INSTALLATION AND CONNECTION

- A. All exposed fixture hardware and piping shall be plated with polished chrome unless otherwise directed in these specifications. Where chair carriers or special carrier design are not indicated, provide wall blocking for anchorage of manufacturers standard mounting bracket.

- B. All fixtures in contact with finished walls and floors shall be caulked with waterproof, white, non-hardening sealant which will not crack, shrink or change color with age.
- C. All fixtures and component parts shall conform to governing codes.
- D. All fixtures shall be securely mounted level and plumb or as recommended by the manufacturer. Mount fixtures intended to be accessible to the handicapped at the dimensions required by code.

### 3.3 STARTUP

- A. Adjust flush valves, pressure reducing valves, mixing valves, water heater thermostats, and similar equipment.
- B. Remove construction protection, tags and labels and thoroughly clean all plumbing equipment and trim. Scour all fixtures just prior to building acceptance.

END OF SECTION 224000

## SECTION 230500 - HVAC MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The provisions of the General Requirements, Supplementary Requirements, and Division 1 apply to the HVAC work specified in this Division.
- B. The requirements of this Section apply to the HVAC systems specified in these Specifications and in other Division 23 sections.
- C. Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the Drawings and/or in these Specifications, including all labor, supervision, services, permits, fees, and incidentals necessary and required to provide a complete and operable facility with complete systems as shown, specified, and required by applicable codes.
- D. The work shall include, but not be limited to, the following systems:
  - 1. Heating and cooling equipment.
  - 2. Complete piping systems including valves, supports, etc.
  - 3. Air handling equipment including packaged equipment and exhaust fans.
  - 4. Air distribution systems including ductwork, terminal units, dampers, insulation, and air inlets and outlets.
  - 5. HVAC condensate drain piping system.
  - 6. HVAC control system.
  - 7. Special systems as specified herein.
- E. Advise subcontractor, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.

#### 1.2 QUALITY ASSURANCE

- A. All work and materials shall conform to all applicable local and state codes and all federal, state and other applicable laws and regulations. All clarifications and modifications which have been cleared with appropriate authorities are listed under the applicable sections. All electrical products shall bear the label of a recognized testing laboratory such as UL or CSA.
- B. Whenever the requirements of the Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. Codes and Standards: Comply with the provisions of the following referenced codes, standards and specifications:
  - 1. Federal Specifications (FS)
  - 2. American National Standards Institute (ANSI)
  - 3. National Electrical Manufacturer's Association (NEMA)
  - 4. National Fire Protection Association (NFPA)

5. Underwriters Laboratories, Inc. (UL)
6. Factory Mutual (FM)
7. International Building Code (IBC) with State and Local Amendments
8. International Mechanical Code (IMC) with State and Local Amendments
9. Uniform Plumbing Code (UPC) with State and Local Amendments
10. American Society for Testing and Materials (ASTM)
11. Americans with Disabilities Act (ADA)
12. International Fire Code (IFC) with State and Local Amendments
13. Energy Policy Act (EPAAct)
14. Manufacturers Standardization Society (MSS)
15. American Gas Association (AGA)

- D. Each piece of equipment furnished shall meet all detailed requirements of the Drawings and Specifications and shall be suitable for the installation shown. Equipment not meeting all requirements will not be acceptable, even though specified by name. Where two or more units of the same class of equipment are furnished, use product of the same manufacturer; component parts of the entire system need not be products of same manufacturer. Furnish all materials and equipment, new and free from defect and of size, make, type and quality herein specified or approved by the Architect. All materials shall be installed in a neat and professional manner.
- E. All apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both.
- G. Drawings: Do not scale drawings for roughing-in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other specification divisions.
- H. Field Wiring: It is the intent of these specifications that all systems shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections provided. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings. All equipment shall be installed in compliance with the Electrical Code and the equipment's UL listing. Bring to the attention of the Architect in writing, all conflicts, incompatibilities, and/or discrepancies prior to bid or as soon as discovered.

### 1.3 WORK OF OTHER CONTRACTS

- A. Work under this contract shall be conducted in a manner to allow for the future installations of such equipment or items listed in other sections of this Specification.

### 1.4 WORK OF OTHER DIVISIONS

- A. Work under this Division shall be conducted in a manner to cooperate with the installation of such equipment or items as specified in other Divisions.
- B. Plumbing piping systems and fixtures and fire suppression piping systems are specified under other Divisions of these Specifications except for provisions or items specifically noted on the

Drawings or specified herein.

- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.
- D. All sections of Division 23 are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any section of Division 23. Individual sections are not written for specific subcontractors or suppliers but for the general contractor.

#### 1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES (SUBMITTALS)

- A. Submit in accordance with Division 1 full technical and descriptive shop drawing data on proposed materials and equipment as detailed in each section.
- B. The Contractor shall verify that all equipment submitted can be delivered and installed within the time constraints of the construction period.
- C. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, and description of physical appearance for each item and option submitted. Reproduction of catalog data sheets shall be clean and legible to show all details, including gauge of metal used.
- D. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with rubber stamp arrow or similar concise method.
- E. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- F. Include field wiring diagrams and connection diagrams for all control and/or low voltage systems, including floor plans.
- G. Submittal Review: The submittal review process is a means to provide quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders." Approval of the data for substitution and shop drawings shall not eliminate the contractor's responsibility for compliance with Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- H. Unless otherwise directed by Division 1, submittal data shall be in a 3-ring plastic binder with a clear plastic sleeve and a project identification sheet inserted. Arrange submittals numerically with specification sections identified on divider tabs. All required sections shall be submitted at one time.



## 1.6 PRODUCT SUBSTITUTION

- A. Materials other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.

## 1.7 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work.

## 1.8 RECORD DOCUMENTS

- A. Project Record (As-Installed) Drawings:
  - 1. Maintain a set of record drawings on the job site as directed in Division 1.
  - 2. Keep Drawings clean, undamaged, and up to date.
  - 3. Record and accurately indicate the following:
    - a. Depths, sizes, and locations of all buried and concealed piping dimensioned from permanent building features.
    - b. Locations of all valves.
    - c. Locations of all fire dampers and other airflow control devices.
    - d. Changes, additions, and revisions due to change orders, obstructions, etc. Eradicate extraneous information.
    - e. Model numbers of installed equipment.
  - 4. Make Drawings available when requested by Architect for review.
  - 5. Submit as part of the required Project Closeout documents.
- B. Operating and Maintenance Manuals: Submit five (5) sets of Operating and Maintenance Instructions, including manufacturer's service data, wiring diagrams, and parts lists and vendors for all serviceable items of equipment, valve charts, balancing data, final control diagrams showing final set points, and any additional equipment added by change order, bound in three-ring, vinyl or canvas covered, loose-leaf binders organized with index and thumb-tab markers for each classification of equipment or data.

## 1.9 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the contractor shall agree to pay for the cost of repair of the reported defect by a contractor of the Owner's choice.
- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and

include the Contractor's labor.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. General: Provide all new materials and equipment, identical to apparatus or equipment in successful operation for a minimum of two years. Provide materials of comparable quality omitted here but necessary to complete the work. Maximum allowable variation from stated capacities, minus 5% to plus 10% as approved in each case.
- B. Compatibility: Provide products which are compatible with other portions of the work and provide products with the proper or correct power and fuel-burning characteristics, and similar adaptations for the project.
- C. Efficiency: Heating and cooling equipment shall comply with ASHRAE Standard 90.1-2010 and the State Energy Code. Where equipment efficiencies are indicated, the use of alternate or substitute manufacturer's equipment with lower efficiencies is not permitted.
- D. Storage and Handling:
  - 1. Delivery: Deliver to project site with manufacturer's labels intact and legible.
  - 2. Handling: Avoid damage.
  - 3. Storage: Inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

### 2.2 ACCESS PANELS

- A. Manufacturers: Inryco/Milcor, Bilco, Elmdor, Karp, Potter-Roemer or accepted substitute. Inryco/Milcor Style DW, K, or M panels as required by construction.
- B. Construction: Flush style, fire rated in fire rated partitions and ceilings. Screwdriver latches on all access panels.

### 2.3 VALVES

- A. General: Provide factory fabricated valves of the type, body material, temperature and pressure class, and service indicated. Bronze gate, globe and check valves shall comply with MSS-SP-80. Ball valves shall comply with MSS-SP-110. Iron gate and globe valves shall comply with MSS-SP-70. Iron check valves shall comply with MSS-SP-71. Butterfly valves shall comply with MSS-SP-67. Valve size same as connecting pipe size.
- B. Acceptable Manufacturers: Milwaukee, Crane, Grinnell, Nibco, Hammond, Stockham, Legend, Watts, and Walworth. Grooved end valves Victaulic, Tyco-Grinnell, Gruvlock, or accepted substitute. NIBCO numbers are given except as noted. Where possible, provide valves from a single manufacturer.
- C. Valve Styles: See individual Division 23 sections for valve styles.

- D. Selection of Valve Ends (Pipe Connections): Select and install valves with ends matching the types of pipe/tube connections.

#### 2.4 HANGERS AND SUPPORTS

- A. General: Provide factory-fabricated horizontal piping hangers, clamps, hanger rod, inserts, supports, etc., of the indicated MSS type and size. The Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry Practice SP-58 and SP-69 are referenced in this section.
- B. Manufacturers: B-Line, Carpenter & Paterson, Grinnell, Michigan, Superstrut, Tolco, Erico, or accepted substitute. Grinnell figure numbers in parentheses where applicable (or other manufacturers as noted).
- C. Corrosion Protection: Provide materials which are zinc plated or factory painted to prevent corrosion. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.

#### 2.5 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. 3M, Metacaulk, SpecSeal, or approved.
- B. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

#### 2.6 ROOF PENETRATIONS

- A. Roof piping, tubing, and conduit penetrations shall be protected by a manufactured penetration assembly. Portals Plus, Inc. or approved.
- B. Roof penetration system shall include continuously welded, 18 gauge galvanized steel roof curb with compatible integral base, acrylic coated ABS curb cap with raised molded opening, EPDM molded cap suitable for penetrating item(s), and stainless steel sealing clamps.

#### 2.7 STARTERS AND SWITCHES

- A. Manufacturers: Cerus Industrial, General Electric, ABB, Allen Bradley, Schneider Electric, Eaton, are approved. Provide starters by same manufacturer throughout project.
- B. General: Provide each motor with starter or switch as approved and recommended by manufacturer of motor or equipment of which motor is a part.

### PART 3 - EXECUTION

#### 3.1 LAYOUT AND COORDINATION

- A. Site Examination: Before starting work, carefully examine site and all contract Drawings. Become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, roughing-in dimensions and equipment locations

before proceeding with any of the work.

- B. Utility Locations: The location of existing utilities, wires, conduits, pipes, ducts, or other service facilities are shown in a general way only on the Drawings and are taken from existing records. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- C. Sleeves, Inserts, Cast-in-Place Work: Provide sleeves, inserts, anchoring devices, cast-in-place work, etc. which must be set in concrete sequenced at the proper time for the project schedule.
- D. Coordination:
  - 1. The drawings are based on equipment of a certain manufacturer and may be identified as such. Where alternate manufacturers or approved substitutes are incorporated into the work, any required design changes are the responsibility of the contractor. Such changes may include changes in utility or system connection sizes, location, or orientation, service clearances, structural support or acoustic considerations.
  - 2. Where the work must be sequenced and positioned with precision in order to fit into the available space, prepare accurate scale shop drawings showing the actual physical dimensions required for the installation and submit prior to purchase/fabrication/installation of any of the elements involved in the coordination.
  - 3. Cooperate with other trades in furnishing material and information for sleeves, bucks, chases, mountings, backing, foundations and wiring required for installation of mechanical items.
  - 4. Coordinate all work with other trades and determine in advance where interfacing of the mechanical work and other work are required to be connected together. Provide all materials and equipment to make those connections. Submit shop drawings showing required connections where special conditions exist.
- E. Discrepancies: Report immediately any error, conflict or discrepancy in Plans, Specifications and/or existing conditions. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of piping be necessary, provide for approval the simplest layout possible for that particular portion of the work.

### 3.2 MECHANICAL EQUIPMENT WIRING

- A. Provide all mechanical equipment motors, automatic temperature, limit, float and similar control devices required, with wiring complete from power source indicated on Electrical Drawings.
- B. Provide properly rated motor overload and undervoltage protection and all manual or automatic motor operating devices for all mechanical equipment.
- C. Equipment and systems shown on the Drawings and/or specified, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system including controls for the actual selected equipment/system.

### 3.3 GENERAL INSTALLATION

- A. Locating and Positioning Equipment: Observe all Codes, Regulations and good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment and comply with Code requirements.
- B. Arrangement: Arrange piping parallel with primary lines of the building construction, and with a minimum of 7' overhead clearance in all areas where possible. Unless indicated otherwise, conceal all piping. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance. Give right-of-way to piping which must slope for drainage. Set all equipment level or as recommended by manufacturer. Under no conditions shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- C. Access Panels: Provide access panels with proper backing reinforcement for all equipment, dielectric unions, valves and items requiring service and installed above ceilings, behind walls, or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels are not necessarily shown on Drawings. Use no panel smaller than 12" by 12" for simple manual access or smaller than 16" x 20" where personnel must pass through.
- D. Adjusting: Adjust and calibrate all automatic mechanical equipment, temperature controls, float devices, etc. Adjust flow rates at each piece of equipment or fixture.
- E. Building Vapor Barrier: Wherever the building insulation vapor barrier is penetrated by piping, hangers, conduits, etc., provide clear self-adhesive tape recommended by the insulation manufacturer around the penetrations.
- F. Condensate drainage: Provide a complete condensate piping system discharging to an approved receptor. Discharging to the exterior is not permitted. Heat trace and insulate all condensate piping located outdoors. See Division 22 for approved piping materials and methods.

### 3.4 VALVE INSTALLATION

- A. General: Comply with the following requirements:
  - 1. Install valves where required for proper operation of piping and isolation of equipment, including valves in branch lines where necessary to isolate sections of piping, and where shown on the drawings.
  - 2. Locate valves in accessible spaces (or behind access panels) and so that separate support can be provided when necessary.
  - 3. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- B. Valve Access: Provide access panels to all valves installed behind walls, in furring or otherwise inaccessible.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Proceed with the installation of hangers, supports and anchors only after the required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) the proper placement of inserts, anchors and other building structural attachments.

1. Install hangers, supports, clamps, and attachments to support piping and equipment properly from the building structure. Use no wire or perforated metal to support piping, and no supports from other piping or equipment. For exposed continuous pipe runs, install hangers and supports of the same type and style as installed for adjacent similar piping.
2. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated or by other recognized industry methods.
3. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at panel points only.

B. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units. Install specified seismic restraints to restrict excessive movement.
2. Install hangers and supports so that equipment and piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Install hangers and supports to provide the indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

C. Pipe Support:

1. Vertical Spacing: Support at base, at equivalent of every floor height (maximum 10' as required by Code) and just below roof line.
2. Screwed or Welded Steel or Copper Piping: Maximum hanger spacing shall be as follows:
3. Install additional hangers or supports at concentrated loads such as pumps, valves, etc. to maintain alignment and prevent sagging.
4. Support Rod: Hanger support rods sized as follows:

	<u>Steel</u>	<u>Copper</u>
1-1/4" and smaller	7' span	6' span
1-1/2" pipe	9' span	6' span
2" pipe	10' span	10' span
2-1/2" & larger	12' span	10' span

<u>Pipe and Tube Size</u>		<u>Rod Size</u>	
<u>Inches</u>	<u>mm</u>	<u>Inches</u>	<u>mm</u>
1/2" to 4"	12.7 to 101.6	3/8"	9.5
5" to 8"	127.0 to 203.2	1/2"	12.7
10" to 12"	254.0 to 304.8	5/8"	15.9

D. Adjust hangers and supports to bring piping to proper levels and elevations.

E. Provide all necessary structural attachments such as anchors, beam clamps, hanger flanges and

brackets in accordance with MSS SP-69. Attachments to beams wherever possible. Supports suspended from other piping, equipment, metal decking, etc., are not acceptable.

- F. Horizontal banks of piping may be supported on common steel channel member spaced not more than the shortest allowable span required on the individual pipe. Maintain piping at its relative lateral position using clamps or clips. Allow lines subject to thermal expansion to roll axially or slide. Size channel struts for piping weights.
- G. Installation of drilled-in concrete anchors shall comply with the manufacturer's instructions for working load, depth of embedment, and spacing between anchors and from the edge of the slab. Use only wedge-style anchors.

### 3.6 EQUIPMENT CONNECTIONS

- A. Provide complete connections for all items of equipment requiring such connections, including incidental piping, fittings, trim and labor necessary for a finished working installation.
- B. Verify the rough-in and finish requirements for all equipment provided under other Divisions of the work and requiring HVAC piping or duct connections with equipment supplier and installer prior to rough-in.

### 3.7 PROTECTION

- A. Protect all work and materials against loss or damage. Close all pipe openings with caps or plugs. At final completion, thoroughly clean and deliver all work and equipment in an unblemished new condition. Keep all motors and bearings in watertight and dustproof covers during entire course of installation.
- B. Protect floors, walls, framing and sheathing where pipe cutting and threading operations are conducted with plastic sheeting under plywood sheets. Extend plastic sheeting beyond the plywood. Clean-up metal cuttings, oil, etc., daily or as necessary to prevent debris from being tracked beyond the protected area. Damages, as determined by the Architect, due to the pipe cutting/threading operation shall be repaired by the responsible trade.

### 3.8 PIPE PENETRATION FIRE STOPPING

- A. Install as recommended by manufacturer and in accordance with the product's UL listing. Below are the minimum installation requirements.
  - 1. Install specified penetrating item(s) with required annular spacing in proper size wall or floor opening. Support penetrating item(s) adequately on both sides of construction.
  - 2. Clean all opening and penetrating item surfaces in penetration area to remove loose debris, dirt, oil, wax, grease, old caulking, etc.
  - 3. If needed or required for gypsum or concrete block walls, install specified galvanized steel wire mesh or sleeve recessed and centered inside wall around penetrating item(s) so that it is snug against perimeter of opening.
  - 4. When required, install specified type and depth of backing material in annular space, recessed to required fill depth of fire stopping caulking.
  - 5. Gun, trowel, and/or pump fire stopping sealant to specified depth in annular space around penetrating item(s). Trowel sealant surfaces flush with wall or floor surfaces to a smooth,

defect-free finish. Where required, apply specified size caulking bead around penetrating item(s) at zero annular contact areas and tool smooth.

### 3.9 HVAC WORK CLOSEOUT

- A. General: Refer to the Division 1 sections for general closeout requirements. Calibrate all equipment requiring same. Complete each system as shown or specified herein and place in operation except where only roughing-in or partial systems are called for. Each system shall be tested and left in proper operation free of leaks, obstructions, or contamination.
- B. Record Drawings: Submit record set of drawings as previously specified in this Section.
- C. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect present, and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system and replace dirty filters, excessively worn parts and similar expendable items of the work.
- D. Operating Instructions: Conduct a walk-through instruction seminar for the Owner's personnel who are to be involved in the continued operation and maintenance of the HVAC equipment and systems. Provide written instructions outlining and explaining the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

END OF SECTION 230500



## SECTION 230590 - TESTING, ADJUSTING AND BALANCING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Work Included: After completion of the work of installation, test and regulate all components of the new heating, air conditioning and ventilating systems to verify air volumes and heating-cooling flow rates indicated on the Drawings.
- B. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.
- C. Balancing Organization:
  - 1. Balancing of the Heating and Air Conditioning Systems: Performed by a firm providing this service established in the State of Oregon.
  - 2. Provide all necessary personnel, equipment, and services.

#### 1.2 SUBMITTALS

- A. Balancing Data: Include the following minimum information in the Operation and Maintenance Data, as specified in Section 230500.
  - 1. Names or initials of personnel performing the balancing.
  - 2. Dates balancing was performed.
  - 3. List of balancing instruments utilized.
  - 4. Weather conditions at the time of the test.
  - 5. Mechanical system descriptions.
  - 6. All motor rated voltages, amps, starter and overload protective device sizes.
  - 7. All motor operating data.
  - 8. Fan cfm, rpm, operating static pressures, driven and motor sheave data, and all drive changes necessitated to obtain design capacities. List actual minimum outside air volumes measured for each system.
  - 9. All supply, return and exhaust air outlet cfm readings.

#### 1.3 DETAILED REQUIREMENTS

- A. Adjusting and Balancing:
  - 1. Prior to beginning the balancing work, obtain from the Architect the latest version of the mechanical drawings including addenda, revisions, change orders, etc.
  - 2. Adjust and balance all portions of the mechanical systems to produce indicated results within limits of minus 5 or plus 10 percent.
  - 3. Adjust diffuser throws as shown on the drawings (shown as directional arrows).

END OF SECTION 230590

## SECTION 230700 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the insulation of mechanical equipment specified elsewhere in these specifications.
- B. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Minimum Insulation Thickness and Thermal Performance: Comply with the provisions of the State of Oregon Energy Efficiency Specialty Code (OSEEC).
- B. Composite (Insulation, Jacket or Facing and Adhesives) Fire and Smoke Hazard Ratings: Not to exceed a flame spread of 25 or smoke development of 50 and containing less than 0.1% by weight deca-PDE fire retardant.
- C. Component Ratings of Accessories (Adhesives, Mastics, Cements, Tapes, Finishing Cloth for Fittings): Same as "B" requirements above and permanently treated. No water soluble treatments.

#### 1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. General: In addition to the requirements specified in Section 230500, the following apply:
  - 1. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
  - 2. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation. Remove such insulation from project site.

#### 1.4 SUBMITTALS

- A. Submit catalog data and performance characteristics for each product specified.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Insulating Manufacturers: Johns Manville, Knauf, Armstrong, Owens-Corning, Pittsburgh Corning, Pabco, Imcoa, Nomaco, or Certain Teed. Johns Manville products are listed unless indicated otherwise.
- B. Adhesive Manufacturers: Foster, 3M, Insul-Coustic, Borden, Kingco or Armstrong.

## 2.2 PIPING INSULATION

- A. Pipe Temperatures Minus 30 to 180 Deg. F: Flexible, preformed, pre-slit, self-sealing elastomeric pipe insulation, thermal conductivity of 0.27 BTU/hr. sq. ft./in. at 75 deg. F and vapor transmission rating of 0.2 perms/inch. Armstrong "Armaflex 2000" or, in concealed locations, Imcoa or Nomaco also approved.

## 2.3 DUCT INSULATION

- A. Interior Above Grade Ductwork: Glass fiber formaldehyde-free blanket with "FSK" facing containing less than 0.1% by weight deca-PDE fire retardant, k value = 0.31 at 75 deg. F, 0.2 perms, and UL 25/50 surface burning rating. Johns Manville "Microlite."

## 2.4 INSULATION ACCESSORIES

- A. Insulation Compounds and Materials: Provide rivets, staples, bands, adhesives, cements, coatings, sealers, welded studs, etc., as recommended by the manufacturers for the insulation and conditions specified except staples not permitted on chilled water lines.

## PART 3 - EXECUTION

### 3.1 PIPING INSULATION

- A. Refrigerant Piping Insulation: Insulate suction piping with minimum 1" thick foamed plastic or of thickness necessary to prevent condensation at 85 deg. F and 70% RH. Where possible, slip insulation over the piping as it is installed. Seal all joints and seams.
- B. Condensate drains: Insulate drains exposed to outdoor temperatures with 1/2" thick elastomeric pipe insulation. Insulate over heat tape.

### 3.2 DUCTWORK INSULATION

- A. Ductwork: Insulate the following:
  - 1. All supply ductwork.
  - 2. All supply and return ductwork in systems routed in unconditioned spaces or exposed to the outside conditions.
  - 3. All outside air intake ducts.
  - 4. All exhaust ductwork downstream of last backdraft damper.
  - 5. All ductwork required to be insulated by code.
- B. Insulation Thickness: Select board and blanket insulation of thickness required to provide the following installed R-value.
  - 1. All heating or cooling system supply and return ducts located on the exterior of the insulated building envelope and all outside air intake ducts, R-8.
  - 2. All heating and cooling system supply and return ducts located in unconditioned spaces, R-5.
  - 3. All heating and cooling system supply ducts located in conditioned spaces where exposed in unfinished spaces or concealed from view in finished spaces, R-3.3. Exposed

ductwork in finished spaces shall not be externally insulated.

- C. Fittings: Install with wire, straps, and duct adhesive as required. To prevent sagging on all rectangular or square ducts over 24" wide, install Gramweld or equal welding pins on the bottom. Maximum spacing 18" on center in both directions.
- D. Installation: Applied with butt joints, all seams sealed with vapor seal mastic or taped with 2" wide vapor-proof, pressure-sensitive tape. Seal all penetrations with vapor barrier adhesive.
- E. Internally Lined Ductwork: Where internally lined ductwork is indicated on the Drawings and/or specified, no exterior insulation is required. Select duct lining to provide the required R-value. Carefully lap the ends of the exterior insulation a minimum of 6" past the interior insulation unless otherwise shown. Seal the end of vapor barrier jacket to the duct with mastic where the vapor barrier is required. Duct lining is specified in Section 23 30 00.

END OF SECTION 230700

## SECTION 231000 - FACILITY FUEL GAS SYSTEMS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the fuel gas distribution systems for the facility.
- B. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 CODES AND STANDARDS

- A. Comply with the provisions of the following referenced codes, standards and specifications:
  - 1. National Fire Protection Association (NFPA)
  - 2. Underwriters Laboratories, Inc. (UL)
  - 3. Factory Mutual (FM)
  - 4. National Fuel Gas Code (NFPA 54)
  - 5. Liquefied Petroleum Gas Code (NFPA 58)
  - 6. International Mechanical Code (IMC) with State and Local Amendments
  - 7. American Society for Testing and Materials (ASTM)
  - 8. International Fire Code (IFC) with State and Local Amendments
  - 9. American Gas Association (AGA)

#### 1.3 SUBMITTALS

- A. Required for all items.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Black Steel Pipe:
  - 1. Applications: Aboveground or underground.
    - a. Natural Gas.
  - 2. Pipe: Systems 10" or smaller, operating below 400 psi, schedule 40, standard black steel pipe ASTM A-120 or A-53.
  - 3. Underground Piping: Coated with a minimum of ten mils of factory applied 100% thermosetting epoxy resin.
  - 4. Threaded Fittings: For above ground installations only. Banded class 150 malleable iron fittings, ANSI B16.3 to 150 psi.
  - 5. Welding Fittings: Standard weight, seamless steel, beveled end fittings, ANSI B16.9.
  - 6. Flanged Fittings: For above ground installations only.
    - a. Class 150 steel welding neck flanges, ANSI B16.9 to 150 psi.
    - b. Facing and Gasketing: Selected for service pressures and temperatures. Raised

face for steel flanges.

B. Flexible Fuel Gas Piping (CSST):

1. Application: 2 psi or less:
  - a. Natural gas
2. Pipe: Corrugated 300 series stainless steel tubing with yellow polyethylene jacketing.
3. Fittings: Fittings shall be yellow brass and provide a self-flaring connection to the tubing. Systems incorporating gaskets or o-rings are not acceptable.
4. Underground Installations: CSST pre-sleeved with heavy wall internally ribbed polyethylene secondary venting conduit with end seals and vent connection fittings.
5. Approvals: System shall be listed by an approved independent laboratory and approved for use by the local code officials. TracPipe, Gastite, or approved.

2.2 PIPING ACCESSORIES

A. Fuel Gas Valves: UL listed or AGA approved valves.

1. 10 psig or Less:
  - a. Ball: NIBCO bronze body T/S 585-70-UL, brass body FP-600.

B. Gas Pressure Regulators: Size based on pressures indicated on the drawings and for 1.5 times connected load. Style and model as approved by Northwest Natural Gas Co. Maxitrol, Rockwell, Fisher, Reliance, or approved substitute.

C. Gas Appliance Connectors: For low pressure gas connection to indoor or outdoor rigidly mounted stationary appliances, AGA approved corrugated stainless steel tubing with zinc plated steel end fittings. Brasscraft or approved substitute.

D. Solenoid Gas Shutoff Valve: Normally closed solenoid valve, ASCO or approved.

2.3 EXPANSION JOINTS AND LOOPS

A. Flexible Expansion/Seismic Loop: Factory fabricated assembly consisting of two elbows and return bend or three elbows, and two lengths of flexible hose to allow free movement in three axis. Return bend or elbow shall include a drain/vent fitting. Hose shall be corrugated metal style with metal overbraid compatible with the piping materials. Connections to match piping system except connection 2" and larger shall be flanged style. Listed for fuel gas use. Metraflex "Metraloop" or Unisource "Uni-loops".

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Locating and Positioning Equipment: Observe all Codes and Regulations and good common practice in locating and installing mechanical equipment and material so that complete installation presents the least possible hazard. Maintain adequate clearances for repair and service to all equipment. Installation of any equipment with less than minimum clearances

shall not be accepted.

- B. Anchorage: Anchor and/or brace mechanical equipment and piping to resist displacement due to seismic action.
- C. Gas Pressure Regulators: Install with drip leg at regulator inlet and capped test tees at inlet and outlet piping connections. Vent to exterior in accordance with code requirements except where vent limiting devices are installed.

### 3.2 PIPE INSTALLATION

- A. General: Install pipe, tube and fittings in accordance with recognized industry practiced for each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections.
- B. Ferrous Threaded Piping: Thread pipe in accordance with ANSI 82.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave no more than 3 threads exposed.
- C. Flexible Gas Piping (CSST): Comply with manufacturer's recommendations for system installation. Provide striker plates and supports as required. All penetrations of finished walls, including mechanical room walls, shall be accomplished using surface or recessed termination fittings. Where installed underground below a building, vent the conduit to outdoors per Code.
- D. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.
- E. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
- F. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.
- G. Underground Gas Piping: Standard schedule 40 black steel pipe with welding fittings coated with a minimum of ten mils of 100% thermosetting epoxy resin, Scotchkote No. 203 factory applied per resin manufacturer's recommendations. Wrap all joints with 10 mil polyvinyl chloride pipewrap tape to a total thickness of 40 mils. Provide one 15 pound magnesium anode per each 100' of underground pipe, attached to coupling or other fitting with No. 10 copper wire. No underfloor slab natural gas piping except as provided for by code.

### 3.3 GAS SERVICE

- A. Contact Northwest Natural Gas Co. service as required and pay all costs involved. Run all gas distribution piping and make final connections to all gas using equipment. Install regulators to deliver proper inlet pressures and vent regulators to outside where required.

### 3.4 CLEANING

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary.
- B. Fuel Piping: Blow clear of debris with nitrogen or oil free air.

### 3.5 TEST

- A. General: Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.
- B. Natural Gas Piping: One half hour minimum air at 60 psig for 2 psig gas, and 15 minutes at 10 psig for 7" water gauge natural gas or as approved and certified by serving utility.
- C. Storage Tanks: Test tank according to manufacturer's recommendation.

### 3.6 MECHANICAL PAINTING

- A. Uninsulated Piping: Paint black steel piping in moist equipment rooms, crawl spaces, inside of secondary containment piping, or exposed to weather two (2) coats black rust-inhibiting paint.

END OF SECTION 231000



## SECTION 233000 - AIR DISTRIBUTION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide Air Distribution Materials as specified herein and as shown on the Drawings.
- B. Material characteristics and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Air Distribution Equipment Rating: In accordance with AMCA certified rating procedures and bearing the AMCA label.

#### 1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for all manufactured materials.
- B. Submit operating and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL

- A. Quality Assurance: Galvanized steel sheet metal except where otherwise indicated. Metal gauges, joints and reinforcement in accordance with Mechanical Code, ASHRAE and SMACNA standards. Ductwork shall be fabricated to the following pressure classifications:
  - 1. Return and local exhaust ducts: 1" negative.
  - 2. Central exhaust system ducts: 2" negative.
  - 3. Supply ducts from fan discharge to diffuser: 1" positive.
- B. Acoustical Duct Lining: Schuller "Linacoustic," Gustin Bacon "Ultra-Liner", Owens Corning "Aeroflex", and Certainteed "Tough Guard" approved, meeting NFPA 90A requirements for maximum flame spread and smoke developed. Mechanically attach lining to sheet metal duct with Schuller Grip Nails or Gramweld welding pins. Apply fire-retardant type adhesive similar to Schuller No. 44 adhesive, Benjamin Foster 81-99, Insul-Coustic 22 or 3M equivalent on all leading edges, joints and seams.
- C. Duct Sealants and Adhesives:
  - 1. For joints and seams exposed to the weather in lieu of soldering, United "Uni-Cast" system or approved.

2. Joint & Seam Sealants (Water Based): Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
  3. Liner Adhesive: Water based, fire and moisture resistant, used to adhere insulation to metal duct. It shall comply with NFPA 90A and UL 723 requirements.
  4. Duct Liner Sealant: Water based sealant, fire and moisture resistant, used to encapsulate fiberglass duct insulation to eliminate airborne fibers. Must comply with UL requirements.
  5. Duct Sealing Tapes: Provide a UL 181B listed duct sealing system.
- D. Optional Duct Joints for Sheet Metal Ducts: "Ductmate System" by Ductmate Industries, Inc., Ward Duct Connectors, Inc., Mez Industries, or acceptable substitute. Spiramir self-sealing round duct connector system meeting Class 3 leakage standards with EPDM o-ring seal.
- E. Concealed Round Duct: Round and flat oval spiral seam duct shall be manufactured of galvanized sheet metal with spiral lock seam. Construction, gauges, and reinforcement in accordance with SMACNA standards. Fittings shall be manufactured of galvanized steel with spot welded or riveted and sealed seams or continuously welded seams. Snap lock longitudinal seam duct shall fully comply with SMACNA standards for duct gauge and seam type for appropriate pressure class. Adjustable elbows shall be minimum 24 gauge.
- F. Flexible Ductwork-Low Pressure: Low pressure flexible duct, factory fabricated assembly consisting of a zinc-coated spring steel helix mechanically attached to reinforced aluminized polyester fabric tube. The composite assembly, shall meet the Class 1 requirements of NFPA Bulletin No. 90-A and be labeled by Underwriters Laboratories, Inc., with a flame spread rating of 25 or less and a smoke developed rating of 50 or under. Flexmaster, Genflex, ATCO, Wiremold, Thermaflex, Glassflex, Clevepak, Schuller, or accepted substitute.

## 2.2 ACCESSORIES

- A. Manual Volume Dampers: Construct of material two gauges heavier than duct in which installed; single plate up to 12" wide; multiple over 12" wide. Hem both edges 1/2" and flange sides 1/2" on rectangular dampers. Use Young, Duro-Dyne, MAT, or accepted substitute damper accessories. Install with bearings at each end of damper shaft and with locking quadrant. **Location of all volume dampers is not necessarily shown on Drawings; minimum required is one in each supply, return or exhaust main, and one in each branch to a diffuser or a grille.**
- B. Fire Dampers:
1. Static Fire Dampers: Constructed and installed in accordance with NFPA No. 90A and UL labeled.
  2. Dynamic Fire Dampers: Constructed and approved in accordance with UL Standard 555 for horizontal or vertical installations. Selection of dampers shall not exceed manufacturer's recommended CFM at 4" of static pressure for unducted dampers and 8" of static pressure for ducted dampers.
- C. Fire Rated Thermal Blanket and Diffuser Fire Damper: UL listed, non-asbestos ceramic thermal blanket for use on ceiling diffusers with curtain type fire damper to fit diffuser neck indicated.

D. Combination Fire/Smoke Dampers:

1. Constructed and installed in accordance with NFPA No. 90A, UL labeled. Provide dampers with rating equal to surrounding construction where penetrations are made through fire-resistant rated construction per applicable codes.
2. Provide access panels of proper fire rating. Size dampers to maintain free area through damper same as unobstructed run of duct or opening.
3. Each damper shall be classified by UL as a "corridor damper" for installation in tunnel corridors, shall be rated for one hour fire resistance under UL555, and shall have a minimum leakage rating of Class II under UL555S for use in smoke control systems. Each damper shall bear a UL label designating the damper as "corridor damper."
4. In addition to the leakage rating specified herein, the dampers and their actuators shall be classified under UL555S to an elevated temperature of 250 degrees F (121 degrees C). Appropriate electric motorized operators shall be installed by the damper manufacturer at time of fabrication and damper/actuator assembly shall be factory cycled 10 times to assure operation. Assembly shall meet all applicable UL555 and UL555S criteria for both damper and actuators. Damper shall be power open-fail close design.
5. Damper manufacturer shall provide factory assembled minimum 20 gage steel sleeve. Damper shall be sealed to the sleeve with a 25/50 flame spread/smoke developed sealant material. Each corridor damper shall be equipped as standard with an electric fusible link. These fusible links shall be rated for 165 deg. F (74 deg. C) and shall be easily resettable for system testing.
6. Provide all necessary wiring and devices to close dampers on a signal from the building fire alarm system.

E. Exterior Wall Louvers: Prefabricated galvanized sheet metal fixed stormproof blades with frame to suit building construction, and with 1/2" x 1/2", 16 gauge galvanized wire mesh on back side of all intake louvers and insect screen on exhaust/relief louvers. 4" deep, 45 degree fixed drainable type blade, AMCA 500 tested for 800 fpm without water penetration, and maximum of 0.07" wg intake pressure loss and 0.09" wg exhaust pressure loss. Provide "Kynar" protective coating and stainless steel fasteners (ASTM A167, type 302, cadmium finish, ASTM A165 type NS). Ruskin L375D as basic pattern on blade and frame, Greenheck, Cesco, American Warming, or approved.

F. Outside Air Intake/Relief Head: Rectangular aluminum cap with curb connection, flashing, 1/2" mesh galvanized bird screen and hinged access. Greenheck, Cook, Exitaire, Carnes, Acme, Powerline, Penn or accepted substitute.

G. Wall Caps: Rain screen style wall caps with extended base with flange and backdraft damper. Insect screen on bath fan outlets. No screen on dryer outlets.

H. Locking Connection Straps: 1/2" wide positive locking steel straps or nylon self-locking straps. Panduit or accepted substitute.

2.3 GRILLES, REGISTERS AND DIFFUSERS

A. Description: Provide grilles, registers and diffusers as shown on the Drawings.

- B. Finishes:
  - 1. Steel: Flat white enamel prime coat, factory applied on ceiling diffusers. Others are to have a baked enamel finish, color as selected by Architect.
  - 2. Aluminum: Anodized clear finish unless indicated otherwise.
- C. Manufacturers: Carnes, Krueger, Titus, Price, Shoemaker, and Tuttle & Bailey are accepted substitutes where only Titus model numbers are listed. Where other manufacturer's products are listed and/or "accepted substitute" is indicated, only the products or an accepted substitute for that item shall be provided.
- D. Perforated Face Diffusers: Perforated snap-in or concealed hinged face plate with internal deflection blades at diffuser neck in steel or extruded aluminum frame and margin to suit the ceiling construction. Provide with opposed blade volume damper. Panel size shall be 24" x 24" where lift-out tile ceiling system is indicated. Titus PCS.
- E. Ceiling Matched Return and/or Exhaust Register: To match adjacent ceiling outlets type. Use in spaces containing ceiling diffusers and/or T-bar ceilings. Provide with damper except where dampered plenums are indicated. Titus PCR.
- F. Sidewall Supply Register: Double deflection grille with face bars parallel to long dimension on ceiling type and horizontal on wall type; bars to be individually adjustable, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 300RL.
- G. Sidewall or Ceiling Return or Exhaust Register: Face bars parallel to long dimension on ceiling type and horizontal on wall type; bars set at 35 degrees to 45 degrees, spaced on 0.66" to 0.75" centers; key operated opposed blade volume damper. Titus 350RL series.
- H. Sidewall or Ceiling Return, Exhaust or Relief Grille: Face bars parallel to long dimension on ceiling type and horizontal on wall type; bars set at 35 degrees to 45 degrees, spaced on 0.66" to 0.75" centers. Titus 350 series.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION

- A. Air Handling Equipment Installation and Arrangement: Install and arrange as shown on Drawings. Comply with the manufacturer's recommendations for installation, connection, and start-up.
- B. Equipment Access Panels: Locate free of all obstructions such as ceiling bars, electrical conduit, lights, ductwork, etc.
- C. Filters: Install specified filters in supply units and systems prior to start-up.

#### 3.2 INSTALLATION OF GRILLES, REGISTERS AND DIFFUSERS

- A. Size and air handling characteristics shall be as shown on the Drawings.

- B. Locate, arrange, and install grilles, registers and diffusers as shown on the Drawings. Locate registers in tee-bar ceilings with diffusers centered on the tile unless indicated otherwise.

### 3.3 DUCTWORK INSTALLATION

- A. Support: Install ductwork with 1" wide strap cradle hangers not more than 8' on centers or as required by code. Support terminal units independent of adjacent ductwork. Attach to available building construction according to good practices for materials involved. Manufactured hanger system acceptable in lieu of fabricated hangers at contractor's option. Ductmate "Clutcher" system or approved.
- B. Elbows and Fittings: Construct elbows with throat radius equal to duct width in plane of turn or make them square and provide double wall, air foil turning vanes.
- C. Fittings: Make transitions and take-offs as shown on Drawings. Provide volume dampers and splitter dampers as indicated on Drawings and as specified. Straight saddle tees are not allowed.
- D. Acoustical Duct Lining: Acoustically line all fan unit intake and discharge plenums, all ductwork indicated as lined on the Drawings, all sheet metal ductwork specified per Section 230700 as insulated, where exposed to view or subject to damage in areas such as mechanical rooms, and, at the Contractor's option, all insulated ductwork specified in Section 230700. The duct size noted on the Drawings is the clear opening of the duct with insulation. Insulation shall not reduce duct size listed.
- E. Manual Volume Dampers: Location of all volume dampers are not necessarily shown on the Drawings. Provide a minimum of one volume damper in each supply, return or exhaust branch.
- F. Duct Insulation: Specified in Section 230700.
- G. Sealing: Seal all ductwork and plenums to make airtight at seams, joints, edges, corners and at penetrations. Install sealant materials in accordance with manufacturer's requirements.
- H. Flexible Duct Connections:
  - 1. Install in full extended condition, free of sags and kinks, using only the minimum length required to make the connection.
  - 2. Make all joints and connections with 1/2" wide positive locking steel straps or nylon self-locking straps. Connecting duct shall have retention bead or flexible duct shall be attached with 2 screws in addition to strap.
  - 3. On vertically suspended ducts, secure with a minimum of three sheet metal screws on a maximum of 8" on center.

### 3.4 FIRE DAMPERS

- A. Provide fire dampers with rating equal to surrounding construction where penetrations are made through fire resistant rated construction per applicable codes and installed in accordance with UL label requirements. Locate fusible links for easy service or replacement and provide access panels of proper fire rating. Size fire dampers to maintain free area through fire damper same as unobstructed run of duct.

### 3.5 SMOKE DAMPERS

- A. Same as fire dampers above except provide complete wiring including electrical connections between field connected components and the fire alarm system specified in the electrical specifications.

### 3.6 NEW DUCTWORK CLEANING

- A. Store all ductwork materials on pallets or above grade, protected from weather, dirt/mud and other construction dust.
- B. Remove all accumulated dust, dirt, etc. from each duct section as it is being installed.
- C. Prior to installation of diffusers, grilles and registers, install temporary system filters and cover all diffuser, grille and register openings with temporary 25% efficiency filter materials and start the fan systems. Operate fans a minimum of 8 hours. Remove all temporary filters at the end of that period.
- D. Clean all diffusers, grilles and registers just prior to project final completion.

END OF SECTION 233000

## SECTION 233400 - HVAC FANS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide Fans as specified herein and shown on the Drawings.
- B. Equipment capacity and size as indicated in the equipment lists on the Drawings.
- C. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.

#### 1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each fan.
- B. Submit operating and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 EXHAUST FANS AND UNITS

- A. Ceiling Cabinet Exhaust Fan: Direct drive, forward curved centrifugal wheel, sleeve bearings, motor and wheel isolated from unit on vibration isolators; provide grille on inlet and duct connection with backdraft dampers or 2-position control damper on discharge. See plan for damper type. Size and capacity as indicated on Drawings. Carnes VCD, Acme V, Penn Zypher, Jenn-Air J-Series, Greenheck SP, Soler & Palau SV, Jen Fan FF, Cook Gemini, Twin City T, Panasonic, or approved. See equipment schedule for type of controls required.
- B. Roof Mounted Exhaust Fan (Direct Drive): Curb mounted on roof; vertical shaft, direct driven, open BI wheel as shown on Drawings with permanently lubricated sealed ball bearings; fan duty motor; bird screen; weatherproof aluminum housing for mounting on square base; capacity as indicated on Drawings. Motor located outside the air stream. Casing to be easily removed for service. Motor and fan assembly to be mounted on rubber vibration isolators. Provide 2-position control damper per code. Provide switch with pilot light for each fan so indicated. Provide factory mounted disconnect. Greenheck G, Cook ACE-D, Twin City DCRD, Captiveaire DR, or approved.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.

### 3.2 AIR HANDLING INSTALLATION

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation connection and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.

### 3.3 CONTROLS

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes.

END OF SECTION 233400



## SECTION 236000 - AIR COOLED HEAT PUMP

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The requirements of this section apply to the air conditioning refrigeration systems.
- B. Equipment capacity and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and bear the ARI label.
- B. Installation Contractor: Manufacturer's authorized installation and start-up agency normally engaged and experienced in air conditioning/refrigeration work.

#### 1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each type and size of refrigeration equipment.
- B. Submit operating and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 AIR CONDITIONING REFRIGERATION SYSTEM

- A. Air-Cooled Heat Pump:
  - 1. Factory-assembled unit incorporating hermetic compressor, condenser coil, condenser fan, refrigerant piping, controls, and power wiring enclosed in a weather-resistant cabinet needing only refrigerant and power and control wiring to be operative. Capacity and efficiency as shown on Drawings.
  - 2. Compressor shall be reciprocating or scroll-type mounted on vibration isolators. Provide with crankcase heater, short cycle protection, and acoustic cover.
  - 3. Condenser section to include copper tube, aluminum fin condensing coil, dynamically balance fan driven by totally enclosed fan motor with permanently lubricated bearings.
  - 4. Refrigerant system to include suction and liquid service valves, test gauge connections, high and low pressure cutouts, filter dryer.
  - 5. Unit shall include internal fused disconnects, starting controls, and internal wiring complying with National Electrical Code and UL listed, for a single field power connection.

6. Include low ambient controller for operation at 40 degrees outside air with low pressure switch bypass.
7. Approved Manufacturers: Trane, Carrier, Lennox, York.

## 2.2 REFRIGERATION SPECIALTIES

- A. General: Provide the following equipment where they are not a part of the factory installed equipment accessories. Select equipment for operation with the refrigerant being utilized and for the pressure and temperature conditions indicated. Sporlan, Alco, Henry, Detroit, or as listed for each equipment.
- B. Thermostatic Expansion Valve: Capacity matched for the system, angle or straight through pattern external equalizer, brass body complete with capillary and remote sensing bulb.
- C. Solenoid Valves: For installation in liquid, suction and/or hot gas circuit as indicated. Brass body, replaceable coil of voltage indicated.
- D. Liquid and Moisture Indicators: Moisture and liquid indicator installed after the liquid line filter dryer.
- E. Liquid Line Filter Dryer: Sealed container up to approximately 10 tons of capacity and replaceable desiccant dryer core and strainer on larger capacity systems.
- F. Charging Valves: Quick coupling type connection with removable valve core.
- G. Service Valves: Install liquid, suction and discharge line valves, all suitable for refrigerant used and location in the system, designed so as to be easily packed with pressure on the line and with wing caps that completely enclose valve stem. Install all purge valves, relief valves or other valves required for safe and proper operation of the system and as may be required by state or local codes. Detroit, Alco, Sporlan or Automatic Products approved substitute.
- H. Pressure Gauges: Provide 0 pound to 300 pound high side and 30" vacuum to 150 pound low side 4-1/2" diameter refrigerant pressure gauges; Marshalltown Fig. 57 or Ashcroft No. 1162. Connect copper tube containing shut-off valve from gauges to refrigerant lines.
- I. Panelboard: Provide approximately where indicated on Drawings or where required or directed, a suitable panelboard for refrigeration system. Install switching equipment, manifolds, control valves, gauges, etc., on panel.
- J. Pressure Relief Valves: Provide refrigerant relief valves from vessels having a volume of 3 cubic feet or greater with discharge piped to atmosphere at a point 15' minimum above adjoining ground level and 20' minimum from any building opening or ventilation opening.
- K. Refrigerant Receiver: ASME Code receiver of sufficient capacity to contain 150% of entire system refrigerant charge. Provide all required connection tappings and fittings and code relief valve. Provide steel base. Pipe relief valve discharge to outside.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Refrigerant Piping System: Refer to Section 232300.

### 3.2 AIR CONDITIONING REFRIGERATION SUBCONTRACTOR

- A. Submit 5 copies of piping diagram for approval. Install all refrigerant piping, major components and all minor components, such as dehydrator, service valves, etc., and arrange piping for hot gas bypass for low load operation. Test system, evacuate, charge, start-up and adjust. Refer to applicable sections of these Specifications for test, evacuation, etc.

### 3.3 ROOF-MOUNTED EQUIPMENT INSTALLATION

- A. Support and anchor all roof mounted mechanical equipment on level, flashed and counterflashed steel curbs suitable for the roof construction. Minimum 12" curb height above the roof unless indicated otherwise on the Drawings. Flashing into the roof is specified in another Specification Section.
- B. Make all piping, electrical and duct penetrations for each equipment within the curb unless shown otherwise on the Drawings. Support all piping and electrical conduit routed above and across the roof on flashed and counterflashed curbs with pipe guides anchored to the curbs in "pitch pockets." Submit shop drawings on other arrangements for approval.

### 3.4 EXTERIOR EQUIPMENT

- A. Support and anchor all exterior mechanical equipment on level curbs or concrete pads minimum 4" above grade unless indicated otherwise on the Drawings.
- B. Make all wall penetrations of piping, electrical and duct work weather and air tight. Provide permanent supports and curbs for all piping and electrical conduit routed exposed with pipe guides anchored to the curbs. Submit shop drawings on other arrangements for approval.

### 3.5 EQUIPMENT START-UP

- A. Furnish services of a trained manufacturer's representative to perform final inspection of the machine and its piping, supervision of prestart-up testing, dehydrating, evacuating, charging, start-up and instruction of Owner's operating staff.

END OF SECTION 236000

## SECTION 237300 - FAN-COIL UNITS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide fan-coil units as specified herein and shown on the Drawings.
- B. Equipment capacity and size as indicated in the equipment lists on the Drawings.

#### 1.2 QUALITY ASSURANCE

- A. Standards: Comply with the following standards:
  - 1. ARI for testing and rating units.
  - 2. ASHRAE 33 for testing air coils.
- B. Codes: Comply with applicable sections of the State Mechanical Specialty Code.
- C. Field Wiring: Comply with requirements of Section 230500, Article 1.2, paragraph D, Field Wiring.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. First Company
  - 2. Carrier
  - 3. Trane
  - 4. Enviro-tech
  - 5. Approved substitute.

#### 2.2 MATERIALS

- A. Chassis: Galvanized steel with flanged edges.
- B. Coil Section Insulation: Faced, heavy density, glass fiber insulation over entire section.
- C. Drain Pans: Galvanized steel with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.
- D. Cabinet: Galvanized steel with removable panels.
  - 1. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge, with safety chain.

E. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer.

## 2.3 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Elements: Nickel-chromium heating wire, free from expansion noise and 60 Hz hum, embedded in magnesium oxide insulating refractory and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16" (4 mm). Element ends are enclosed in terminal box. Fin surface temperature does not exceed 550 deg. F (288 deg. C) at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.

## 2.4 DX COIL

A. Non-ferrous extended surface, counterflow serpentine type with heavy gauge galvanized insulated casing with double sloped, non-ferrous drain pan suitable for mounting required. Assembled with copper tubes brazed to copper headers. Copper or aluminum fins mechanically bonded to tube and spaced a maximum of 15 fins per inch. Construction shall allow for expansion and contraction without developing leaks.

## 2.5 FAN

A. Centrifugal fan with forward curved, DWDI FC fan wheel, directly connected to manufacturer's standard motor.

## 2.6 ACCESSORIES

A. Wiring Terminations: Match conductor materials and sizes indicated. Connect motor to chassis wiring with plug connection.

B. Filters: 1" (25 mm) thick, throw-away filters in frames.

C. Dampers: Steel damper blades with polyurethane stop across entire blade length, operated by factory mounted electric operators for 25 percent open cycle.

D. Provide with electronic, 7-day programmable thermostat and controller system for night-set-back and heating/cooling control sequences. Honeywell or approved substitute.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install fan-coil units as indicated, to comply with manufacturer's written instructions and NFPA 90A.

B. Connect fan-coil units and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts,

according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

- C. Steam and Condensate Piping: Conform to applicable requirements of Division 15 Section "Steam and Condensate Piping." Connect to deaerator tapings with shutoff valves and unions or flanges at each connection.
- D. Connect fan-coil units to steam piping according to Division 15 Section, "Steam and Condensate Piping." Provide shutoff valve and union or flange at each connection.
- E. Connect fan-coil units to hydronic piping according to Division 15 Section "Hydronic Piping." Provide shutoff valve and union or flange at each connection.

### 3.2 FIELD QUALITY CONTROL

- A. Testing: After installing fan-coil units and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units, and retest.

### 3.3 CLEANING

- A. Replace filters in each fan-coil unit.

### 3.4 COMMISSIONING

- A. Startup Services: Engage a factory-authorized service representative to provide start-up service.
- B. Operate fan motor to verify proper rotation.
- C. Operate electric heating elements through each stage to verify proper operation and electrical connections.
- D. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

### 3.5 CONTROLS

- A. Wiring: In accordance with the National Electrical Code and local electrical codes. All thermostat wire shall be minimum 18 gauge, 6 conductor.
- B. Mounting: All controls intended to be operable by the occupant shall be mounted with the operating portion no more than 46" above the floor or as otherwise required by applicable codes.

END OF SECTION 237300

## SECTION 237400 - PACKAGED HVAC UNITS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide Heating, Cooling, and Ventilating Equipment as specified herein and shown on the Drawings.
- B. Equipment capacity and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.
- B. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and ARI labeled.
- C. Gas-fired Equipment: Design certified by American Gas Association.

#### 1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each HVAC unit.
- B. Submit operating and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 ROOF MOUNTED HVAC EQUIPMENT

- A. Packaged Roof-Mounted Gas Heating/Electric Cooling Unit:
  - 1. Manufacturers: Carrier, Daikin, Trane, York or approved.
  - 2. Supply Fan Section: Commercial class air condition duty, direct or belt driven centrifugal air supply fan.
  - 3. Heating Section: AGA and serving utility approved gas burner with stainless steel heat exchanger. Include automatic gas valve, bonnet switch, high limit, main and pilot gas cocks, automatic electric and electronic ignition system, draft diverter and vent.
  - 4. Cooling Section: Include hermetic compressor, capacity matched vertical discharge, air cooled condenser, direct expansion cooling coil, complete refrigeration circuit, including high and low pressure cutouts, short cycling protection, refrigerant filter dryer, etc.
  - 5. Casing: Enclose complete assembly in weatherproof formed steel enameled cabinet with 1" thick, non-organic casing insulation; 1" disposable air filters of standard sizes,

extended housing for downward supply and return air ducts connections; 1/2" galvanized mesh bird screen over rain hood inlet. Mount unit on leveled factory furnished steel support curb with ductwork, electrical connections brought up through the roof within the curb.

6. Economizer: Systems to operate as a 100% OSA unit.
7. Controls: Minimum accessories shall include all necessary internal circuiting and fused disconnects for the following:
  - a. Single field electrical power connection.
  - b. Programmable 7-day, night set back, electronic thermostat and economizer/controller.
  - c. Thermostat shall operate the heating and cooling as required to maintain space temperatures.
  - d. Provide clear plastic guards with separate mounting base over thermostats indicated.
8. Controls shall be as subsequently specified.
9. Provide unit with vibration isolation curb, where indicated on plan.

## 2.2 ROOFTOP VIBRATION ISOLATION BASES

- A. Mount rooftop air handling units on factory fabricated vibration isolation curbs that fit under the isolated equipment. Construct the lower member of rectangular steel tube containing adjustable and removable steel springs that support the upper floating member. The upper frame shall provide continuous support for the equipment and shall be captive so as to resiliently resist wind and seismic forces. A continuous flexible aluminum seal joined at the corners with EPDM bellows shall be nailed to the wooden port frame to weatherproof the assembly. Hardware shall be cadmium plated or galvanized with springs plated or provided with an approved rust-resistant finish.
- B. Acceptable Manufacturers: Mason Industries ISA (**RSA**) sized to fit equipment furnished. Acceptable equivalents - Consolidated Kinetics and Vibration Eliminator Co, Vibrex, Thycurb, Amber Booth, Micrometl.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Refer to applicable sections for piping, ductwork, insulation, painting, etc.

### 3.2 ROOF MOUNTED EQUIPMENT INSTALLATION

- A. All roof mounted mechanical equipment shall be supported and seismically anchored on leveled, flashed and counterflashed curbs anchored to resist seismic forces and suitable for the roof construction. Minimum curb height shall be 12" above the roof unless indicated otherwise on the Drawings. Flashing into the roof is specified in another Section.
- B. Make all piping, electrical and duct penetrations for each piece of equipment within the curb



unless shown otherwise on the Drawings. Piping and electrical conduit shall not be routed across the roof.

### 3.3 AIR HANDLING INSTALLATION

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation, connection, and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.
- C. Filters: Specified filters or approved temporary construction filters shall be installed in supply units prior to start-up or used for drying and/or temporary heat.

### 3.4 SMOKE DETECTOR INSTALLATION

- A. Provide unit or duct-mounted smoke detectors at air handling units in accordance with Code requirements.
- B. Where detectors are mounted in a concealed location, provide remote indicating panel located as directed.
- C. Automatic Smoke Detector Fan Shutdown: Arrange controls to shut down respective air handling system upon detection of smoke.

### 3.5 CONTROLS

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes.

END OF SECTION 237400

## SECTION 238000 - TERMINAL HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Provide Heating, Cooling, and Ventilating Equipment as specified herein and shown on the Drawings.
- B. Equipment capacity and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 230500, Common HVAC Materials and Methods, also apply to this section.

#### 1.2 QUALITY ASSURANCE

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.
- B. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and ARI labeled.
- C. Gas-fired Equipment: Design certified by American Gas Association.

#### 1.3 SUBMITTALS

- A. Submit catalog data, construction details and performance characteristics for each HVAC unit.
- B. Submit operating and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 TERMINAL HEATING EQUIPMENT

- A. Wall mounted electric fan forced heaters: UL listed recessed heater with primary and secondary thermal safeties with secondary manual reset, nichrome heating element, recessed wall can, two stage centrifugal blower, and powder coat metal grille. Provide with remote 2-pole thermostat. Cadet C series, Qmark, Markel, King approved.
- B. Wall mounted Cove Heaters: UL Listed radiant cove heater. King KCV, or equal.

#### 2.2 DUCTLESS SPLIT SYSTEM TERMINAL HVAC EQUIPMENT (SINGLE AND MULTI-SPLIT SYSTEMS)

- A. Indoor Section: Compact fan coil unit designed for wall, ceiling, recessed ceiling, or low profile concealed ducted mounting. Quantity, style, and capacity as listed on the drawings. Multispeed direct drive fan with air filter. Provide with wired thermostat and condensate pump as indicated.

- B. Outdoor Section: Capacity matched with indoor section(s), steel cabinet with hermetically sealed inverter driven compressor(s), accumulator, crankcase heater, high and low pressure switches, restart delay relay, condenser coil, and propeller fans. Low ambient operation to 20 degrees. Single or multiple circuit as indicated. Cooling only or heat pump as indicated on the Drawings. Provide preinsulated lineset for each indoor unit.
- C. Refrigerant R410A refrigerant shall be required. See plan for required refrigerant line piping length and elevation change.
- D. Acceptable Manufacturers: Mitsubishi, Daikin, or approved.

**2.3 PACKAGED TERMINAL HEAT PUMP(PTHP):**

- A. Through-the-wall, air-cooled, packaged terminal heat pump. Controls shall be factory wired and completely enclosed within the unit and be accessible. Fan control shall be a 3-position switch for high, medium, and low fan speeds for cooling and heating. Ventilation control shall be a 2-position control to introduce fresh air to the room or to close the vent. All vent air shall be 100% filtered. Electric heating element with outdoor thermostat lockout.
- B. Hermetically sealed compressor shall be rubber shock mounted and internally spring mounted for quiet operation and vibration isolation. Unit shall operate in heat pump mode down to 28 degrees.
- C. Evaporator and condenser coil shall have copper tubes and aluminum fins.
- D. Evaporator and condenser fans shall be direct driven. Evaporator fan shall be centrifugal type and condenser fan shall be propeller type with a slinger ring for condensate removal.
- E. Room panel shall be acoustically insulated and provide for top air discharge.
- F. Wall sleeve shall be a one-piece sleeve, U-channel reinforced for added strength, for wall installation, fabricated from 18 gauge zinc clad steel and shall include outside architectural grille. Finish on sleeve shall be baked-on epoxy-resin enamel. Grille and sleeve shall be shipped with closure panel at both the front and rear of sleeve and with installation instructions on inside panel. Outside grille shall be mounted in sleeve from inside room. Finish on outside grille shall be either anodized aluminum or baked-on epoxy-resin enamel. Sleeve shall be no more than 42" wide, 18-1/4" high and 16-9/16" deep.
- G. Unit chassis shall be slide-out and shall be shipped separate from sleeve.
- H. Provide with remote 7 day programmable hard-wired thermostat, internal condensate drain kit. LG, or approved equal. See equipment schedule for minimum efficiency.

**2.4 SPLIT SYSTEM HEAT PUMP FAN COILS(IHP/OHP-2, IHP/OHP-13):**

- A. The following specification is the basis of design, and is based around the Daikin SkyAir split system heat pump. Equivalent systems by Mitsubishi, Sanyo, LG, Carrier, Trane, and Samsung are considered equal and may bid on this project.
- B. System Description: The variable capacity, heat pump air conditioning system shall be a Daikin

inverter driven SkyAir series (heat/cool model) split system. The system shall consist of a wall mounted indoor evaporator model exclusively matched to the outdoor condensing unit model .

C. The RZQ outdoor condensing unit models shall be a direct expansion (DX), air-cooled heat pump air-conditioning system, with a variable speed inverter driven compressor & fan motor using R-410A refrigerant. The outdoor unit is a horizontal discharge, variable speed, single fan unit using a single phase power supply.

D. Quality Assurance

1. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
2. All wiring shall be in accordance with the National Electric Code (NEC). The system shall be rated in accordance with Air Conditioning Refrigeration Institute’s (ARI) Standard 210/240 and bear the ARI label.
3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
4. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2002 and installed to resist the wind pressures on the equipment and the supports.
5. The outdoor unit will be factory charged with R-410A.
6. A holding charge of dry nitrogen shall be provided in the evaporator.
7. System efficiency shall meet or exceed 16.0 SEER and 9.2 HSPF.

E. Limited Warranty

1. Daikin AC (Americas), Inc. (“Daikin AC”) warrants to the customer who is the original owner and user of the Daikin AC products specified above (“Customer”) that under normal use and maintenance for comfort cooling and conditioning applications such products (the “Products”) will be free from defects in material or workmanship. This warranty applies to parts only and is limited in duration to one (1) year from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment by Daikin AC. Customer must present proof of the original date of receipt and of installation of the Product in order to establish the effective date of this warranty. Otherwise the effective date will be deemed to be the date of manufacture plus sixty (60) days. Repaired or replacement parts are warranted for the balance of the warranty period applicable to the original part following the date on which the repaired or replacement part is provided to the Customer.

F. Extended Warranty

1. For its compressors only, Daikin AC provides the above warranty (which is applicable to parts only) for a six (6) year period. This extended warranty for compressors is limited in duration to six (6) years from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment by Daikin AC, and applies to the compressor and compressor parts only. The effective date of this extended warranty shall be established as above.

- G. Installation Requirements: The system must be installed by a Daikin factory trained contractor/dealer.
- H. Performance: See drawings for capacities required.
- I. Refrigerant Piping: The system shall be capable of refrigerant piping up to 164 total feet with a 98 feet maximum vertical difference, without any oil traps or additional components.
- J. Outdoor Unit: The outdoor condensing unit is designed specifically for use with matched capacity SkyAir series indoor evaporator units.
1. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a Daikin swing compressor, motors, fan, condenser coil, electronic expansion valves, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, service ports and suction accumulator.
  2. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.
  3. The outdoor unit can be wired and piped with outdoor unit access from the left, right, front or rear.
  4. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit.
  5. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for re-programming.
  6. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
  7. The following safety devices shall be included on the condensing unit; high pressure switch, control circuit fuses, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
  8. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
  9. The outdoor unit shall be capable of cooling & heating operation at 0°F dry bulb ambient temperature without additional low ambient controls.
- K. Unit Cabinet:
1. The outdoor unit model RZQ\_\_PVJU9 shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
- L. Fan:
1. The condensing unit shall consist of one propeller type, direct-drive 70 W fan motor that has multiple speed operation via a DC (digitally commutating) inverter.
  2. The fan shall be a horizontal discharge configuration with a nominal airflow maximum of 1,835 cfm.
  3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
5. The outdoor unit shall be capable of operating at further reduced sound levels during night time.

M. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure highly efficient performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1.
5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

N. Compressor:

1. The Daikin swing compressor shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed swing "F-type" type.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The compressor shall be equipped with a crankcase heater, high pressure safety switch and internal thermal overload protector.
5. The compressor shall be mounted to avoid the transmission of vibration.

O. Electrical:

1. The power supply to the outdoor unit shall be 208-230 volts, 1 phase, 60 hertz +/- 10%.
2. The control voltage between the indoor and outdoor unit shall be 16VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, thus simplifying the wiring operation.
4. The control wiring lengths shall be as shown below:

	<b>Outdoor to Indoor Unit</b>	<b>Outdoor to Central Controller</b>	<b>Indoor Unit to Remote Control</b>
Control Wiring Length	6,665	3,330	1,665
Wire Type	18 AWG, 2 wire, non-polarity, non-shielded, stranded		

P. Wall mounted unit

1. General: Daikin indoor unit model shall be a wall mounted fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. It shall be connected to the corresponding SkyAir series outdoor condensing unit. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with Daikin BRC1E71 programmable controller, BRC2A71 simplified controller or optional wireless controller.

Q. Performance: Each units performance shall meet capacities shown on plan.

R. Indoor Unit:

1. The Daikin indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be individually insulated from the outdoor unit.
4. The indoor units shall be equipped with a condensate pan
5. The indoor units shall be equipped with a return air thermistor.
6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
7. The voltage range will be 253 volts maximum and 187 volts minimum.

S. Unit Cabinet:

1. The cabinet shall be located into the ceiling and ducted to the supply and return air openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

T. Fan:

1. The fan shall be direct-drive statically and dynamically balanced impeller with two fan speeds.
2. The fan motor shall be thermally protected.

U. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. A condensate pan shall be located under the coil.
3. A thermistor will be located on the liquid and gas line.

V. Electrical:

1. A separate power supply will be required of 208-230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

W. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. A full array of fault diagnostics shall be accessible via the wired remote controller.

X. Required Accessories Available:

1. Remote "in-room" sensor kit KRCS01-4B (recommended).
  - a. The Daikin wall mounted, hard wired remote sensor kit is recommended for applications where there could be a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).
2. Navigation Remote Controller (BRC1E71)
3. Condensate pumps where required for drainage.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.

### 3.2 AIR HANDLING INSTALLATION

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation connection and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.

### 3.3 CONDENSATE DRAINAGE



- A. Provide complete condensate drainage system for cooling and heat pump equipment. Route condensate to approved interior receptor. Discharging condensate to the exterior is not permitted. See Division 22 for piping materials and methods.

#### 3.4 CONTROLS

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes. All thermostat wire shall be minimum 18 gauge, 6 conductor.
- B. Mounting: All controls intended to be operable by the occupant shall be mounted with the operating portion no more than 46" above the floor or as otherwise required by applicable codes.

END OF SECTION 238000