

# SECTION 15010 – GENERAL MECHANICAL

## PART 1 - GENERAL

### 1.1 Work Included:

- A. The General Conditions, Supplementary General Conditions and Division 1 - General Requirements are a part of this Section.
- B. Furnish all labor, materials, tools, equipment and services, necessary and incidental, to install all mechanical work and related systems shown on the Drawings, indicated in the Specification or necessary to provide a finished installation. The finished installation shall be in perfect working condition and be ready for continuous and satisfactory operation.
- C. Unless specifically mentioned as work to be done by others, all instructions and requirements in Specifications and on Drawings shall be performed by the Principal Contractor for this Division of the work. The following definitions shall apply.
  - 1. Where the word "provide" is used in connection with a system, equipment or item, it shall be construed to mean the furnishing and installing of the systems, equipment or item.
  - 2. Where the phrase "as directed" is used, it shall be construed to mean as directed by the Architect or his authorized representative.
- D. The installation of the mechanical systems shall include, but not be limited to, the following:
  - 1. Provide a complete plumbing soil and vent system from the sewer line 5'-0" outside the building to all plumbing fixtures.
  - 2. Provide a complete domestic water distribution system from the water line 5'-0" outside the building to all plumbing fixtures.
  - 3. Provide a complete natural gas distribution system from the meter to all gas appliances.
  - 4. Provide split system heat pumps with hot water heating coils.
  - 5. Provide in-floor radiant heating system with gas fired boilers.
  - 6. Provide supplemental electric heat.
  - 7. Provide zone damper system.
  - 8. Provide an air distribution system to include registers, grilles, diffusers and all other duct appurtenances.

9. Provide exhaust fans.

1.2 Related Work:

- A. Division 1 - General
- B. Division 3 - Concrete
- C. Division 5 - Metals
- D. Division 16 - Electrical

1.3 Quality Assurance:

A. Qualification of Manufacturers:

- 1. Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of satisfactory production acceptable to the Engineer.

B. Qualification of Contractors:

- 1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper installation of the work of this Section and of the work in the other required sections.
- 2. Contractors are to be licensed and qualified to make mechanical installations.

C. Codes and Standards:

- 1. All equipment furnished under this Specification shall be free from defects in workmanship and materials. All equipment, systems and work shall meet the requirements of the latest edition published by the following organizations as minimum standards.

Air Moving and Conditioning Association.

Underwriter's Laboratories, Inc.

American Society of Heating, Refrigeration, Air Conditioning Engineers.

American National Standards Institute.

Local Plumbing Regulations.

Sheet Metal and Air Conditioning Contractors National Association.

Local Gas Supplier Requirements.

- 2. All work shall also meet the minimum requirements of codes and standards of local and state agencies having jurisdiction.

- D. Include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.4 Permits and Inspections:

- A. Obtain and pay for all necessary drawings, permits and certificates required by the various governing agencies having jurisdiction. Deliver to the Architect, all permits for construction before starting work and certificates of test, inspection and approval before the date of final acceptance of the job.

1.5 Review and Materials:

- A. Where the Specifications and Drawings state that equipment shall be manufactured by one specified manufacturer "or approved equal", the subcontractor shall submit proposals in the form of shop drawings for alternative equipment that is equal in quality, durability, appearance, strength, performance, design, physical dimensions and arrangement to the equipment offered by the specified manufacturer.
- B. The Contractor may provide a substitute that is equal to any product specified and if the Contractor wishes to provide a proposed substitute, he shall make written application to the Engineer for approval of such substitute, certifying in writing that the proposed substitute shall perform adequately the duties imposed by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified. This shall be done at least 10 days prior to bid opening. Late applications will not be considered. Approval of substitute products will be issued by addendum only.
- C. Where a Subcontractor proposes to use an item of equipment other than that specified or detailed on the Drawings that is approved by the Engineer and that requires redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, then such redesign, additional work, new drawings and detailing required for it shall be provided without extra compensation.

PART 2 - PRODUCTS

2.1 Equipment:

- A. All equipment shall be the capacity and types specified and as shown on the Equipment Schedule in the Drawings and shall be the listed manufacturer and model number or shall be an equal approved in advance by the Engineer.
- B. All materials and equipment furnished and installed under this division of the Contract shall be new, of standard first grade quality and correctly designed for

their specific purpose.

- C. All equipment and materials furnished shall be the manufacturer's standard item of production unless specifically specified or required to be modified to suit job conditions. Sizes, material, finish, dimensions and the capacities for the specified application shall be published in catalogs for national distribution by the manufacturer. Ratings and capacities shall be certified by a recognized rating bureau.
- D. All materials and equipment of one and the same kind, type or classification and used for identical purposes shall be made by the same manufacturer.

### PART 3 - EXECUTION

#### 3.1 Local Conditions:

- A. Examine the premises and observe the conditions under which work will be done and all other circumstances which will affect the mechanical work before submitting bid. The submittal of a bid will indicate that the Mechanical Contractor has full knowledge of the problems involved in the performance of the work.
- B. Verify, in the field, scale dimensions on plans.
- C. Contractor shall note that portions of the existing building will remain operational during construction.
- D. Check architectural, structural and electrical plans to avert possible installation conflicts.
- E. Prior to installation of materials and equipment, discrepancies between plans and actual field conditions or between plans and specifications shall promptly be brought to the attention of the Architect for a decision.

#### 3.2 Mechanical Drawings:

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Drawings are not to be scaled. The Architectural Drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Architect.
- B. The Contractor shall follow Drawings in laying out work and check drawings of other trades to verify spaces in which work shall be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

- C. The locations shown on the Drawings are approximate and are to serve as a guide for installation. The shifting of locations to meet field conditions (before installation) will be expected and this shall be done at no increased cost.
- D. The general arrangement of ducts, piping and equipment shall be as shown on the Contract Drawings. Detailed drawings of proposed changes because of field conditions or other causes shall be submitted to the Architect for approval. Such changes shall be made without additional cost to the Owner. The Contractor shall carefully examine all Contract Drawings and shall be responsible for the proper fittings of materials and equipment in each location, as indicated.

### 3.3 "As Built" Drawings:

- A. A separate set of white background Mechanical prints marked in red ink "As Built" shall be kept in good condition at the job site during progress of construction. Mark to indicate changes as they occur in the field installation of equipment.
- B. Show location of equipment, pipes, etc.
- C. At all times, these Drawings shall be up-to-date and available at the site for verification. Before final payment is approved, the Drawings shall be made correct and delivered to the Architect.
- D. At the completion of the job, the contractor shall obtain the AutoCAD drawing files from the Engineer at cost (\$50.00) and update file from the "as-built" drawings. The updated AutoCAD files shall also be delivered to the Architect.

### 3.4 Coordination With Other Trades:

- A. The Contractor shall coordinate the mechanical work with all other trades. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of all piping systems and mechanical equipment. All mechanical work shall be installed in proper sequence with other trades without any unnecessary delay.
- B. The Contractor shall confer with all subcontractors engaged in the construction of the project, regarding work which may in any way affect his installation. Whenever interferences occur, before installing any of the work in question, the Contractor shall consult with all subcontractors and shall come to an agreement with them as to the exact location and level of his piping and/or parts of his equipment.
- C. The Contractor shall be solely responsible for the proper arrangement of his piping and equipment.

### 3.5 Operations and Maintenance Manuals:

- A. Furnish 3 sets of Operation Manuals in loose leaf binders. The manuals shall include:
1. Descriptive brochures on all equipment.
  2. Maintenance instructions.
  3. Lubrication schedule.
  4. Parts list for all equipment.
  5. ASME Certificates for equipment as required.
  6. Service phone number of installing company.
  7. Table of Contents.
  8. ATC diagrams.

3.6 Instruction of Owner's Representative:

- A. Instruct the Owner's Representative in the proper operation and maintenance of all elements of the mechanical systems. A minimum of 8 hours shall be spent in formal instruction. Each person present at the training shall complete a sign in sheet. The sign in sheet shall have the minimum categories: name, company, signature, position held with company, training date, start time, end time & training type. At the completion of the training the contractor shall submit this form for approval.

3.7 Warranty:

- A. All materials, equipment and workmanship shall be warranted to be free from defects and shall be maintained by the Contractor for a period of one year from the date of formal completion and acceptance of the project.

3.8 Completeness:

- A. It is the intent of these Specifications to provide a complete system. Completeness shall mean not only that all material and equipment has been installed properly, but that all material and equipment has been installed and has been adjusted and that, in the opinion of the Architect/Engineer, all material and equipment is operating as designed and specified.

(END OF SECTION)

# SECTION 15100 – GENERAL PRODUCTS AND MATERIALS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Supports and Anchors.
- B. Vibration Isolation.
- C. Identification and Painting.
- D. Flashing.
- E. Sleeves.
- F. Electric Motor and Coordination.
- G. Accessibility.
- H. Protection.
- I. Thermometers and gauges.
- J. Guides and Expansions.

### 1.2 Related Work:

- A. Section 15110 - Pipe and Pipe Fittings.
- B. Section 15120 – Valves, Cocks and Faucets.
- C. Section 15130 – Trenching and Backfill.
- D. Section 15850 - Ductwork.
- E. Division 3 - Concrete.
- F. Division 16 - Electrical.

## PART 2 - PRODUCTS

### 2.1 Hangers and Supports:

- A. Pipe and Equipment.
  - 1. Clevis Hanger - Black steel, copper-plated for copper pipe or steel.

2. Trapeze Hangers - Steel channels with welded spacers and hanger rods.
  3. Wall Support - Cast iron hook.
  4. Vertical - Steel riser clamp.
  5. Pipe Covering Saddles - 16 gauge galvanized steel (12" long, half round).
- B. Inserts - Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for form attachment.
- C. Anchors.
1. Pipe anchors - Steel collars, clamps or similar devices welded to pipe and secured to building structure.
  2. Equipment Anchors - Hook type "J" bolts.
- D. Sleeves shall be Schedule 40 steel or PVC pipe, flush with surface to be penetrated.
- E. Thermometers and Gauges.
1. Thermometers shall be red reading mercury type, 7" scale swivel type and well socket. Weksler Type AA5 or approved equal by Terice or Taylor.
    - a. Heating 30-240 degrees in 2 degree increments.
  2. Gauges shall be Bourdon type, bronze type. Aluminum or phenolic case, 4 ½" dials with gage cock, Weksler Type CA1 or approved equal by Terice or Taylor.
    - a. Heating 0-60 psi in 1 psi increments.
- F. Flexible Pipe Connectors.
1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
  2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.

### PART 3 - EXECUTION

#### 3.1 Vibration Isolation:



- A. All equipment shall operate without objectionable noises or vibrations as determined by the Architect. If such objectionable noises or vibrations should be produced and transmitted to the occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical system, the Contractor shall make the necessary changes and/or additions, as approved by the Architect without extra cost to the Owner to eliminate the noises or vibrations.
- B. Provide vibration isolation as shown on the Drawings as specified by Mason, Flexonics, Vibration Mountings and Controls or Korfund.

### 3.2 Electrical Motors and Coordination:

- A. Motors shall be of sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity and under the most severe conditions likely to be encountered. Horsepower and voltage characteristics shall be as indicated. All motors shall be dripproof high efficiency unless otherwise indicated. Single-phase motors shall be furnished with built-in thermal protection.
- B. Provisions of Division 16 apply to all wiring required under this Division.
- C. Provide to the Electrical Contractor, data on all equipment to be furnished under Division 15.

### 3.3 Accessibility:

- A. Provide access doors or panels for concealed portions of the work requiring accessibility for operation and maintenance. Minimum door size is 12" x 12". Door to be same rating as system in which they are installed.
- B. Install all mechanical work to permit removal (without damage to other parts) of fan shafts and wheels, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance.

### 3.4 Protection and Tests:

- A. Tests.
  - 1. Leave concealed or insulated work uncovered until required tests have been completed.
  - 2. Conduct pressure, performance and operating tests as required for each system or equipment unit in the presence of the Architect/Engineer or their designated representative.
  - 3. Obtain certificates of approval in compliance with regulations or agencies having jurisdiction.

4. Testing shall prove conclusively that the work is in accordance with these Specifications.

B. Protection.

1. The Contractor shall protect all work and material from damage by his work or workmen and shall be liable for all damage thus caused.
2. The Contractor shall be responsible for work and equipment until finally inspected, tested and accepted. He shall protect work against theft, injury or damage and shall carefully store material and equipment received on site which are not immediately installed. He shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of obstructing material.

3.5 Cutting and Patching:

- A. Refer to the General Conditions for cutting and patching responsibility.
- B. Other Divisions of this Contract will provide sleeves through new concrete, walls and slabs and will construct chases for pipes and ducts in new walls, providing this Division furnished accurate information in time to do the work. If the data is incorrect or not given in time, this Division is responsible for the required cutting.
- C. No cutting of structural members, nor the drilling of holes through beams shall be done without the specific permission of the Architect.

3.6 Sleeves:

- A. Provide sleeves for all pipes passing through wall, foundation and partitions by galvanized steel sleeves through the full thickness of construction. Sleeve shall be a minimum of ½" larger than enclosed pipe and insulation. Terminate floor sleeves 1" above finished floor. Caulk sleeves on walls and floor with fire rated caulk. Penetrations of fire-rated assemblies shall be sealed with a UL rated fire-retardant sealer system.

3.7 Hanger and Supports:

- A. Pipe hangers for service on all horizontal overhead runs of pipe shall be of heavy wrought iron or malleable iron construction, approved adjustable type, designed to permit withdrawal and replacement of hangers without dismantling the pipe and of a size proportionate with the weight of the pipe supported.
  1. Insulated copper tubing - black steel clevis hanger with pipe covering protection saddles sized for the insulating diameter.
  2. Uninsulated copper tubing - copper-plated black steel clevis hanger.

3. Uninsulated steel pipe - black steel clevis hanger.

### 3.8 Identification and Painting:

#### A. Painting.

1. Do not paint factory enameled surfaces. Retouch as necessary to restore finish to original condition.
2. Carefully clean all other portions of the work and leave in "First Class" condition for painting. Painting is under another division of this Contract.

#### B. Identification.

1. All equipment shall have securely attached, a manufacturer's nameplate, giving data as to design and operation characteristics. Nameplates shall not be painted, covered or otherwise obscured.
2. All operational equipment, control devices and similar equipment shall have nameplates giving the name and number of the item of equipment. Nameplates shall be two-toned engraved or embossed plastic. Nameplates shall be securely attached to the equipment or panel or where this is not practicable, they shall be attached by brass link chains.
3. All new exposed piping through the building, all piping installed within accessible shafts and all piping installed in accessible spaces above ceilings under this Division shall have stenciled legend, giving the nature of the service, i.e., "Hot Water Return", together with stenciled arrows indicating the direction of flow. Characters to be not less than 1 ½" high, generally, and not less than 2" high where the pipes are 12' or more above the floor. Legends and arrows shall be placed adjacent to each change of direction and intermediately not over 50' apart. Pipe legends shall conform to ANSI color code A13.14975.

#### C. Valves.

1. Identify all valves provided under this Division with a grommited tag attached to the valve by a brass chain.
2. Tag information to include valve number and service of valved line.
3. Provide additional metal signs attached to adjacent pipe by brass chains, giving pertinent warnings, sequencing information, etc., as required.
4. Prepare lists of all valve tags, giving the number and location of each valve and the equipment or portion of the system controlled. Prepare separate lists for each of the piping services, color-coded to match the valve tags and prepared with consecutive numbers for all valves within the

same zone.

5. Provide one copy of all valve tag lists, each enclosed in a glazed metal or hardwood frame with glass cover and hung where directed.
6. Provide one copy of all start-up procedures, valve positioning, sequencing, switch-overs, pertinent warnings, etc., for all systems, enclosed in glazed metal or hardwood frames and hung where directed.
7. Provide 3 bound copies of all valve tag lists and start-up procedures (see 5 and 6 above) prepared in directory form, as approved.

3.9 Flashing and Counter Flashing:

- A. Flashing of all roof openings will be under another division of this Contract except that the work in this Division includes flashing of vents. Coordinate with roofer on flashing boot.
- B. Provide weatherproof and watertight counterflashing for all roof openings required for the work in this Division.

3.10 Anchor Bolts:

- A. Provide and set in place, at the time foundations, bases and curbs are poured, all anchor bolts as required for the work.
- B. Set bolts in pipe sleeves of approximately twice the bolt diameter and length equal to the embedded length of the bolt.
- C. When the equipment is set in its proper position, the bolt sleeves and space between the rough foundations, bases or curbs of the equipment shall be completely filled with thin cement grout.

3.11 Escutcheons:

- A. Provide all exposed plumbing short branch connections to fixtures and/or equipment passing through wall or floors with pressed brass, chromium-plated, solid-type escutcheons.

3.12 Pipe Expansions:

- A. The installation of all pipes shall be as to allow for expansions using offsets, expansion loops and swing joints as may be necessary to prevent undue strain on piping and connected equipment. Pipe guides shall be installed where required for proper installation of the expansion systems. Install in accordance with the standards of the Expansion Joint Manufacturer's Association.

(END OF SECTION)

# SECTION 15110 – PIPE AND PIPE FITTINGS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Pipe, Fittings and Connections.

### 1.2 Related Work:

- A. Section 15100 – General Products and Materials.
- B. Section 15120 – Valves, Cocks and Faucets.

### 1.3 Quality Assurance:

- A. Provide certification from the manufacturer that their product conforms to the requirements of the appropriate standard.
- B. Provide welder certification.

## PART 2 - PRODUCTS

### 2.1 Pipe and Tube:

- A. Steel pipe, ANSI/ASTM A-53/A-53M, black Schedule 40.
- B. Steel pipe, ANSI/ASTM A-53, black Schedule 40, Grade B.
- C. Steel pipe, ANSI/ASTM A-53/A-53M, cold rolled, grooved, black schedule 40.
- D. Copper tube ASTM B88, seamless type L, hard. Copper tube ASTM B 306 drainage tube (DWV).
- E. Copper tube ASTM B88, seamless type K, soft.
- F. PVC plastic pipe ASTM D-2665, D-1784 Schedule 40 DWV.

### 2.2 Pipe and Tube Joints and Fittings:

- A. Steel pipe fittings, ANSI/ASME B16.3, malleable iron threaded 150 lb.
- B. Steel pipe fittings, ASTM A-105, grooved steel.
- C. Wrought copper, solder joint, ANSI/ASME B16.22.
- D. PVC plastic drainage, ANSI/ASTM D-2665, D-1784.

2.3 Unions:

- A. Malleable iron unions, galvanized, Class I (150 psi), bronze-to-iron ground joint, Federal Specification WW-W531, ASTM A-126, ASTM-153.
- B. Cast bronze unions, solder joint, ground union joint.

PART 3 - EXECUTION

3.1 Materials:

- A. Domestic Water Piping.
  - 1. Above ground, type L, copper tubing (hard) with wrought fittings.
  - 2. Below ground, type K, copper tubing (soft) with wrought fittings.
- B. Sanitary and Vent Piping.
  - 1. Above ground, plastic PVC Schedule 40 DWV with PVC drainage fittings.
  - 2. Below ground, cast iron soil pipe service weight with drainage fittings.
- C. Natural Gas Piping.
  - 1. Above ground, steel pipe, black, Schedule 40 with malleable iron threaded fittings.
- D. Condensate.
  - 1. Schedule 40 PVC pipe and drainage fittings.
- E. Refrigerant Piping.
  - 1. Copper tube type "ACR" hard capped and cleaned with brazed silfoss connections.

3.2 Installation - General:

- A. For purposes of clearness and legibility, piping drawings are essentially diagrammatic and indicate only sizes, connection points and routes. It is not intended or implied that all offsets, rises and drops are shown. Install piping as required to fit structure, avoid obstruction and retain clearances, access, headroom, openings and passageways.
- B. Run all piping parallel and straight with adjacent walls or ceilings. Run concealed in finished rooms.

- C. Set all rough-ins exactly to measurements furnished by the manufacturer, except as noted on the Drawings or in the respective equipment schedule.
- D. Use fittings for all offsets or changes in direction of piping. Springing, bending, or forcing of pipe is prohibited.
- E. Run piping free of traps, sags, or bends. Grade and valve for complete drainage and control of the system.
- F. Keep all openings in the work covered or plugged to prevent accumulation of obstructions in the system.
- G. Cut pipe and tubing squarely and remove burrs to full diameter of pipe. Remove metal particles and clean each section of foreign materials before assembling.
- H. Cut pipe threads to full depth of die. Threads to comply with ASA B2.1 and to be cut with clear, sharp dies.
- I. Piping shall include all vents required and low points of the system shall include drain valves and hose connections.
- J. Pressure piping shall be neither embedded in concrete nor concealed below floor slab within buildings, except where specifically indicated on the Drawings.
- K. No pipes shall be placed so that they will be likely to freeze unless they are fully protected against freezing by some method acceptable to the Architect.
- L. Reduced fittings shall be used wherever possible. The use of bushings shall be held to a minimum. Eccentric reducers shall be used throughout, except in vertical lines, in which case, concentric reducers can be used. All connections to equipment shall be made with unions (ground joint or flanged) and elbow swings to facilitate easy removal of equipment. Connections to equipment with sizes smaller than piping shall have the reduction in size made at the final connection, i.e., reducing elbow or stop.

### 3.3 Pipe Joints and Connection:

- A. Steel Pipe.
  - 1. Screwed pipe up through 2" - apply pipe cement or dope to the male thread only.
  - 2. Flanged joints shall be faced true, provided with gaskets and made perfectly square and tight. All gaskets shall be as thin as the finish of the flange face permits.
  - 3. Grooved Pipe - Grooved pipe couplings shall be Victaulic, Stockham,

Grinnell, or approved equal. Couplings shall be Victaulic Style 77 and/or Style 75 or approved equal with housing fabricated in two or more parts of ductile iron castings in accordance with ASTM A536, Grade 65-45-12. Coupling gasket shall be Victaulic Grade "E" EPDM or approved equal, per ASTM D2000. Coupling bolts shall be oval neck track head type with hexagonal, heavy nuts, per ASTM A-183. All pipe fittings used with grooved couplings shall be fabricated of ductile iron or malleable iron castings in accord with ASTM A-536 or ASTM A-47. Where malleable castings are not available, standard fittings fabricated with Schedule 40 steel pipe or standard wall seamless welded fittings with grooved ends may be used. Before assembly of couplings, lightly coat pipe ends and outside of gaskets with cup grease or graphite past to facilitate installation. Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.

B. Plastic PVC Pipe.

1. Form solvent joints in PVC pipe and fittings to ANSI/ASTM D-2855.
2. Cut pipe square and clean surfaces to be joined. Provide cleaning solvent and primer prior to cementing. Apply cement to both surfaces and turn the pipe slightly while inserting to assure even distribution.

C. Copper Tubing.

1. Form hot soldered joints in copper, brass or bronze fittings with 95-5 solder.
2. Defective joints shall be disassembled, cleaned and resoldered.

D. Dielectric Connections.

1. Steel or cast iron to copper pipe connections shall be made using electrolysis preventing dielectric unions. Direct contact between ferrous and nonferrous metals will not be permitted.

E. Refrigerant Piping.

1. Form hot brazed joints in copper, brass, or bronze fittings with silfoss solder.
2. Defective joints shall be disassembled, cleaned, and brazed.

(END OF SECTION)



# SECTION 15120 – VALVES, COCKS AND FAUCETS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Ball Valves.
- B. Check Valves.
- C. Plug Cocks.
- D. Drain Valves.
- E. Balance Valves.

### 1.2 Related Work:

- A. Section 15110 - Pipe and Pipe Fittings.

### 1.3 Submittals:

- A. Submit detailed shop drawings. Clearly indicate make, model, location, type, size, and pressure rating.

## PART 2 - PRODUCTS

### 2.1 Manufacturer:

- A. Provide valves of same manufacturer throughout, where possible.
- B. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- C. Valves shall be NIBCO or approved equal by DeZurik, Jenkins, Stockham or Milwaukee.
- D. Balancing valves shall be Bell & Gossett Circuit Setters or approved equal by TACO or Griswold.

### 2.2 Drain Valve:

- A. Drain valve, bronze compression stop with hose thread. NIBCO #74.

### 2.3 Plug Valve:

- A. Plug Valve, 175 psi non-shock W.O.G.

1. Semi-steel, screwed joint, permanently lubricated bushing. DeZurik Figure 425 or approved equal.

2.4 Check Valve:

- A. Check valve, 125 psi S.S., 200 psi non-shock W.O.G., bronze ASTM B-62.
  1. Swing check, screw cap, composition disc, screwed joint, Stockham B-310 NIBCO T-413-Y.
  2. Swing check, screw cap, composition disc, solder joint, Stockham B-311 NIBCO S-413-B.

2.5 Balancing Valve:

- A. Bronze body/brass ball with differential pressure readout ports and calibrated name plates. Provide one calibrated meter for the building. Valve to be Bell and Gossett Circuit Setter or approved equal by Taco or Griswold.

2.6 Ball Valve:

- A. Screwed joint Nibco T-580 or approved equal.
- B. Solder joint Nibco S-580 or approved equal.

2.7 Vent Valves:

- A. Manual Vent Valves: Provide manual vent valves designed to be operated manually with screwdriver or thumbscrew, 1/8" N.P.T. connection.

PART 3 - EXECUTION

3.1 General:

- A. Install valves at all service connections and machinery or equipment, in all branch lines, at headers and at such points as may be required for sectionalizing purposes. Wherever possible, valves shall be located on the piping so that they can be reached from elements of the building with minimum recourse to the use of ladders.
- B. The individual connections to equipment shall be provided with valves and unions, accessible located and arranged to permit their easy servicing or removal.
- C. Valves installed in horizontal piping shall have stem no lower than the center of the pipe. Where inverted valve stem installations are necessary due to structural conditions, etc., permission must be obtained from the Architect before proceeding with valve installation.

3.2 Service:

A. Domestic Water.

1. 2" and smaller, Gate 125 psi solder or threaded.

B. Natural Gas Service.

1. Plug valve 175 psi threaded

(END OF SECTION)

# SECTION 15130 - TRENCHING AND BACKFILL

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Trenching and backfill for mechanical work.

### 1.2 Related work:

- A. Division 2 - Sitework.

### 1.3 Quality Assurance:

- A. All backfill material and compaction shall be in accordance with Division 2.

## PART 2 - PRODUCTS

### 2.1 Suitable Materials:

- A. Materials suitable for backfill shall meet the criteria of Division 2.

## PART 3 - EXECUTION

### 3.1 Trenching and Backfill:

- A. Excavate and backfill all trenches and other excavations required for completing the work of this Division. All excavation required shall be "unclassified".
- B. Excavation required for the placement of drainage and sanitary systems and other under ground utility installations shall be in conformance with the drawings and as described herein.
  - 1. Contractor shall perform all excavation of trenches to widths and depths for proper laying of pipe. All excavation shall be made by open cut. Banks of trenches shall be kept as nearly vertical as possible and, if required, shall be properly sheeted and braced. Trenches shall not be less than 12" nor more than 16" wider than the outside pipe diameter of the pipe and shall be excavated true to line so that a clear space not less than 6" nor more than 8" in width is provided on each side of the pipe.
  - 2. "First Class" or Class B beddings shall be used.
  - 3. Trenches shall be sheathed or braced and pumping or bailing performed as necessary to protect workmen and adjacent structures and to permit proper execution of the work. After piping installed has been tested and has been inspected and approved by the Inspector, the trenches shall be carefully backfilled with the excavation materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or other approved

materials free from large clods of earth or stone, deposited in 6" layers and thoroughly and carefully tamped until the pipe has a layer of not less than one foot.

4. The bottoms of all trenches shall provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length. Where, in the opinion of the Engineer, damage is liable to result from the removal of sheathing, the sheathing shall be left in place. Where rock excavation is required, the rock shall be excavated to a minimum overdepth of 6" below the trench depth and the overdepth filled with 6" of carefully rammed backfill. Unauthorized overdepths in excavation shall be backfilled at the Contractors expense, with crushed stone, slag or gravel, thoroughly tamped.
  5. Should the Contractor encounter springs within the work area or soft soil conditions at the elevations required for load bearing, he shall immediately notify the Engineer and not place any portion of the work on such surfaces until instructions are received from the Engineer.
  6. All materials excavated that are not suitable for backfilling or embankment shall be disposed of off site.
  7. The Contractor shall control the grading in the vicinity of excavations so that the ground surface is pitched to prevent water from running into the trenches. The Contractor shall provide equipment and pump any trench dry in which water has accumulated.
  8. All tests on piping shall be made prior to backfilling.
- C. Backfill required shall be of approved materials or sand 12" above the pipe. The materials shall be deposited in 6" layers, 12" layers may be used for the remainder of the trench.
1. Pavement and concrete disturbed by trenching operations shall be replaced with materials equal to adjacent paving.
  2. Backfilling shall be carefully performed and the original surface restored as directed by the Engineer. Compaction to be by mechanical, air or gasoline engine methods. Wherever trenches have not been properly filled or if settlement occurs, they shall be refilled, compacted, smoothed off and finally made to conform with the surface of the ground.
  3. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, sidewalks and utilities. Shoring and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving. Shoring and sheeting materials and placement shall conform to the safety requirements of AGE.

4. All excavations shall be performed to provide drainage from the site to prevent conditions that are detrimental to proper construction procedures and results. Water shall not be permitted to pond within footings or trench excavations. Completed footings and trenches shall be backfilled as soon as possible.
5. Construct proper temporary dams or barriers in excavated areas to prevent flooding of water flowing in from adjacent areas.
6. Compaction shall be to 95% CBR.

3.2 Mass Excavation:

- A. Mass excavation to approximate building levels will be carried out under a section of the architectural specifications. The Contractor shall, however, do all trench and pit excavation and backfilling required for work under this Section of the Specifications, inside and outside the building.

(END OF SECTION)

# SECTION 15180 - INSULATION

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Piping Insulation.
- B. Equipment Insulation.

### 1.2 Related Work:

- A. Section 15190 - Duct Insulation.

### 1.3 Submittals:

- A. Submit shop drawings and samples.
- B. Submit shop drawings which indicate complete material data, a list of materials proposed for this project and indicate thickness of material for individual services.

### 1.4 Standards:

- A. NFPA 255.
- B. ASTM E-84.
- C. UL 723.
- D. ASHRAE 90.1.

## PART 2 - PRODUCTS

### 2.1 Manufacturer:

- A. Certainteed (CSG).
- B. Owens-Corning.
- C. Johns-Manville.
- D. Knauf.
- E. Armstrong.

### 2.2 General:

- A. All insulation shall have a composite (insulation, jacket or facing and adhesive) fire hazard rating as tested by ASTM E-84, NFPA 255 or UL 723, not to exceed

25 flame spread and 50 smoke developed. Accessories such as coatings, tapes and adhesives shall have the same component ratings. All insulating materials or their containers shall have a label indicating compliance with the above rating.

### 2.3 Materials:

#### A. Cold Piping.

1. Insulation - Fine glass fiber insulation, 4 pcf with factory applied vapor barrier jacket, 'K' value at 75 degrees F of 0.26.
2. Jacket - Fire retardant vapor barrier jacket with a self-sealing lap (ASJ-SSL).

#### B. Hot Piping.

1. Insulation - Fine glass fiber insulation 4 pcf with factory applied general purpose jacket, 'K' value at 75 degrees F of 0.26.
2. Jacket - Fire retardant vapor barrier jacket with a self-sealing lap (ASJ-SSL).

#### C. Refrigerant Piping - Foamed plastic of closed cell structure, 'K' value at 75 degrees F of 0.28 with a maximum water vapor transmission rating of 0.1 perms.

## PART 3 - EXECUTION

### 3.1 General:

#### A. Piping.

1. All pipe shall be tested before insulation, and insulation shall be applied over clean, dry surfaces, butting adjoining sections firmly together.
2. Apply insulation to pipe according to manufacturer's published recommendations. Ends of pipe insulation shall be sealed with a fire retardant vapor barrier coating at all fittings and valves and at all joints.
3. Insulate fittings, valves and pump with molded fiberglass fittings. All thicknesses to be equal to that of adjoining pipe covering.

#### B. Outdoor.

1. Cover insulation with VentureClad 1577CW by Venture Tape.

### 3.2 Insulation Thickness:

#### A. Refrigerant Piping – 1/2" thick closed cell foam.



- B. Domestic hot and cold water piping, 1" thick fiberglass.
- C. Heating expansion tank air separator, 2" thick fiberglass.
- D. Heating water supply and return piping - 1" fiberglass.
- E. Air conditioning condensate piping: 1/2" thick fiberglass.
- F. Handicapped lavatory and sink domestic water supplies and trap. Preformed PVC jacketed closed cell insulation (Truebro or approved equal).

(END OF SECTION)

# SECTION 15190 - DUCT INSULATION

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Duct Thermal Insulation.
- B. Duct Acoustic Insulation.

### 1.2 Related Work:

- A. Section 15180 - Pipe Insulation.
- B. Section 15850 - Ductwork

### 1.3 Submittals:

- A. Submit shop drawings.

## PART 2 - PRODUCTS

### 2.1 General:

- A. Insulation materials shall be composite fire and smoke ratings maximum 25 for flame spread and 50 for smoke developed. Adhesives to be waterproof.

### 2.2 Manufacturers:

- A. Manufacturers shall be Certainteed (CSG), Johns-Manville, Owens-Corning or Knauf.

### 2.3 Insulation type:

- A. Flexible fiber glass blanket insulation, 1.0 PCF "K" factor of 0.27 at 75 degrees F. Provide with factory applied reinforced aluminum foil vapor barrier.
- B. Acoustic Lining - Glass fiber insulation with a 'K' factor of 0.24 at 75 degrees F. The exposed surface shall be coated to prevent erosion at velocities below 4000 fpm. The density shall be 1.5 pcf or 2 pcf as listed below.

## PART 3 - EXECUTION

### 3.1 Preparation:

- A. Test ductwork prior to covering.
- B. Clean entire surface and dry prior to installation.

### 3.2 Insulation Schedule:

- A. Supply, Return & Outside Air Concealed Duct.
  - 1. Insulation – Flexible fiber glass blanket.
  - 2. Thickness – 2”.
  - 3. Facing – FSK (Foil Scrim Kraft)
  
- B. Transfer Duct.
  - 1. Insulation – Acoustical fiber glass liner.
  - 2. Thickness – 0.5”
  - 3. Facing – Anti-microbial mat
  - 4. PCF – 1.5

### 3.3 Installation:

- A. Fiberglass Flexible Insulation - Insulation shall be butted with facing overlapping and sealed with fire retardant adhesive and tape. Ductwork shall be installed using a maximum compression of 25%. Ductwork over 24” wide shall be secured on the bottom of the ductwork with mechanical fasteners on 12” centers.
  
- B. Acoustic Lining - Coated duct liner shall be cut to assure overlapped and compressed longitudinal corner joints. Apply liner with coated surface facing the air stream and adhere with 100% coverage of fire retardant adhesive. In addition secure the liner with mechanical fasteners 12" O.C. Ductwork sizes shown are net increase duct size to maintain net area. Acoustical lining shall be installed per SMACNA Standard. Pins shall be sized and installed per manufacturers' recommendations and in no instance shall they compress the liner no more than 1/8” relative to the nominal thickness of the insulation.

(END OF SECTION)

# SECTION 15400 - PLUMBING

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Cleanouts.
- B. Floor Drains.
- C. Hydrants.
- D. Domestic Water Heaters.
- E. System Scope.
- F. Tests.
- G. Recirculation Pumps.
- H. Sump Pump.
- I. Humidifiers.

### 1.2 Related Work:

- A. Section 15110 - Pipe and Pipe Fittings.
- B. Section 15450 - Plumbing Fixtures and Trim.

### 1.3 Submittals:

- A. Submit manufacturer's product data and installation instructions.

## PART 2 - PRODUCTS

### 2.1 Cleanouts:

- A. Provide caulked or threaded type extended to finished floor or wall surface.
- B. Access Covers.
  - 1. Unfinished areas - Round with nickel bronze scored frames and plates.
  - 2. Finished areas - Square or round with depressed center section for floor finish. Wall covers to have chromeplated caps.

C. Manufacturer.

1. Floor - Zurn ZN-1400-T or approved equal by Josam, Wade or Mifab.

2.2 Floor Drains:

A. General.

1. Provide caulked or threaded type, extended to finished floor.
2. Round or square cast iron with nickel bronze strainer.

B. Manufacturer.

1. Mechanical Rooms - Zurn ZN-610 or approved equal by Josam, Wade or Mifab.
2. Toilets - Zurn ZN-415S8 or approved equal by Josam, Wade or Mifab.

2.3 Hydrants:

A. General.

1. Anti-siphon, non-freeze, wall type.
2. Flush or with box, bronze construction, polished face with key handle.

B. Manufacturer.

1. Exterior - Zurn Z-1310-PB or approved equal.

2.4 Domestic Water Heaters:

A. General.

1. Type and capacity as scheduled on the Drawings.
2. Units shall be rated in accordance with ASHRAE 90-80.

B. Type.

1. Electric water heater shall be UL listed, factory tested, glass lining at 150 psi working pressure. Unit shall have extruded high density magnesium anode with electric element of zinc plated copper sheath. Controls shall include a thermostat and high temperature cutoff. The jacket shall provide access and enclose the fiberglass insulation. Unit shall carry a 5 year warranty and be rated under ASHRAE 90A-80.

C. Manufacturer.

1. Water heaters shall be manufactured by A.O. Smith or approved equal by Lochinvar, or Ruud.

2.5 Backflow Preventer:

- A. Double check type (007 Series) consisting of two spring-loaded poppet check valves, replaceable seats, two gate valves, four test cocks and one diaphragm operated differential relief valve. Unit to be rated at 150 psi working pressure and 210 degrees F water temperature. Unit to be Watts or approved equal by Hersey Beeco, Watts, Ames or Wilkins.

2.6 Thermostatic Mixing Valve:

- A. Cast copper silicon alloy body, thermostatic actuator, inlets with angle stops and integral check valves and strainers. Provide temperature adjustment knob with vandal-proof screw. Unit to be "Lead Free" and ASSE 1069, 1090 and 1017 compliant. Unit to be Powers LFLM495 or approved equal by Lawler or Symmons.

2.7 Domestic Hot Water Recirculation Pumps:

- A. Pumps shall be in-line type suitable for horizontal or vertical installation.
- B. The body shall be bronze cast iron, 175 psi working pressure with gauge, vent, and drain ports.
- C. Impeller shall be of non-ferrous material, enclosed type, dynamically balanced and keyed to shaft.
- D. Seals shall be an internally-flushed mechanical seal with ceramic seat suitable for continuous operation at 225 degrees F.
- E. Pumps shall be Bell and Gossett or approved equal by Amtrol/Thrush or TACO.

2.8 Sump Pump:

- A. Pump to have a 1-1/2" discharge connection and be of bronze fitted construction with submersible sealed motor, stainless steel shaft, and waterproof cord. Unit to be 120V/1Ph, 3450 RPM with fully submersible controls. Zoeller or approved equal by Myers, or Goulds.

PART 3 - EXECUTION

3.1 Installation:

- A. Install in accordance with specified manufacturer's recommendations.
- B. Provide shock absorbers in the water supply piping at each piece of equipment

and fixture having a quick closing valve in the water supply line. Shock absorbers to be sized in accordance with manufacturer's recommendations.

3.2 Scope:

- A. Provide a sanitary drainage system from the existing sewer line inside the building to all fixtures and components as shown.
- B. Provide a water distribution system from the water line inside the building to all fixtures and components as shown.
- C. Provide a natural gas distribution system from the gas meter to all appliances.
- D. Provide plumbing demolition.
- E.

3.3 Tests:

- A. Provide all temporary piping and connections to test the system as follows.
  - 1. Domestic water piping, perform a hydrostatic test at 125 psi for 24 hours and prove the system tight.
  - 2. Sanitary piping, fill the new drain and vent piping with water. Test no part of the piping with less than a 10' head of water, except the uppermost 10'. The water level must remain at the top of the system for a minimum of 30 minutes.
  - 3. Upon completion of all tests and necessary repairs or replacements, all new hot and cold water piping shall be flushed for 10 minutes.
  - 4. For natural gas piping, provide test of the gas piping in accordance with the local gas company's requirements.

3.4 Disinfection:

- A. Completely disinfect the piping and system components with a solution of sodium hypochlorite as directed by the local health department.

(END OF SECTION)

# SECTION 15450 – PLUMBING FIXTURES AND TRIM

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Plumbing Fixtures.
- B. Plumbing Trim.

### 1.2 Related Work:

- A. Section 15120 – Valves, Cocks and Faucets.
- B. Section 15400 - Plumbing.

### 1.3 Submittals:

- A. Submit manufacturer's product data and installation instructions.

## PART 2 - PRODUCTS

### 2.1 General:

- A. Fixtures shall be as scheduled on the Drawings.
- B. Provide new fixtures, free from flaws and blemishes, with finished surfaces clear, smooth and bright.
- C. All visible portions of fixture brass and accessories shall be heavily chrome plated.

### 2.2 Fixtures:

- A. Water closet shall be pressure assisted tank type floor mounted, water-saver type with elongated bowl. Construction shall be vitreous china with integral trap.
- B. Lavatory shall be wall-mount, vitreous china or cast iron with integral overflow and splash. Provide wall bracket or concealed arm hangers.
- C. Sinks shall be counter-mount, type 302 stainless steel, self-rimming with undercoating, pre-drilled 18 gauge polished to a 6K finish.
- D. Electric water cooler shall be wall, floor surface or recess-mounted. Unit to be 100% lead free of stainless steel construction with HFC-134A hermetic compressor and condenser. Housing shall include integral supply grille and waste. Recessed units to be complete with rough-in box. Handicapped unit to be complete with pushbar.



E. Mop Sink - Shall be floor mounted enameled cast iron with drain.

2.3 Trim:

A. Faucets.

1. Lavatory - Chromeplated brass, metering type, washerless, combination supply fitting with indirect lift waste and aerator.
2. Laundry - Chromeplated brass, exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, wall flange and integral screwdriver stops.
3. Mop Sink - Chromeplated brass, exposed wall type supply with cross handles, vacuum breaker, hose end spout.
4. Kitchen - Chromeplated brass, washerless, combination supply fitting with swivel spout, hose spray and crumb cup strainers.

B. Seats - Five ply, solid plastic, elongated, closed or open front with or without cover. Complete with self-sustaining stainless steel hinge.

C. Miscellaneous.

1. Tailpieces - 17 gauge, chromeplated.
2. Trap - 17 gauge, chromeplated.
3. Flexible supplies and valve - Chromeplated.
4. Trap wrap - ADA fixtures, ASTM E-84-01.

2.4 Manufacturer:

- A. Vitreous China - American Standard or approved equal by Kohler, Eljer/Zurn, or Crane.
- B. Sinks (Stainless Steel) - Elkay or approved equal by Just.
- C. Mop Sink - Fiat or approved equal.
- D. Electric Water Cooler - Elkay or approved equal by Halsey-Taylor, Haws, or Oasis.
- E. Brass - Delta Cambridge or approved equal by Kohler, Moen, Zurn or American Standard.

## PART 3 - EXECUTION

### 3.1 Installation:

- A. Install all fixtures in accordance with the manufacturer's recommendations and the plumbing code.
- B. Clean all fixtures upon completion.
- C. Provide suitable carriers for all wall-mounted equipment.
- D. Provide rough-in dimensions per the manufacturer's recommendations.

(END OF SECTION)

# SECTION 15600 - HEAT GENERATION

## PART 1 - GENERAL

### 1.1 Work Included:

- A. High Efficiency Gas Fired Modulating Condensing Boiler.

### 1.2 Related Work:

- A. Section 15700 - Liquid Heat Transfer.

### 1.3 Submittals:

- A. Submit shop drawings and product data.
- B. Submit manufacturer's installation instructions.
- C. Submit manufacturer's descriptive literature, operating instructions and maintenance and repair data.

### 1.4 Quality Assurance:

- A. Boiler shall be installed in accordance with ASME Standards, NEC and local codes.
- B. The boiler is to be ASME listed.
- C. The boiler shall be UL rated.
- D. The boiler shall be AGA listed.

## PART 2 - PRODUCTS

### 2.1 Manufacturer:

- A. Unit shall be Mod Con or approved equal.

### 2.2 General Requirements:

- A. Boiler
  - 1. Factory-packaged unit, complete with jacket, gas manifold, modulating burner and controls mounted and wired, as specified in this Section.
  - 2. The complete boiler shall be factory fire tested by the manufacturer and a copy of the firetest report shall be supplied with the unit.

3. The primary heat exchanger shall be constructed of stainless steel and provide for access
4. The wall thickness of the primary heat exchanger tubes shall be no less than 0.072" with fin spacing of no less than 7 fins per inch.
5. The heat exchanger shall encompass the entire burner and be enclosed in stainless steel with a full water-backed tube sheet.
6. Each boiler shall be contained in a minimum 18-gauge steel jacket protected with a powder-coated finish. The unit shall be able to operate with any jacket panels removed during inspection or maintenance periods.
7. The boiler shall be 94% thermal efficiency minimum.

#### B. Fuel Burning System

1. Radiant non-corroding Iconel burner.
2. Burner operation shall be Full Modulation with minimum 5:1 turn down.
3. The entire firing control sequence shall be monitored by a UL approved commercial-type microprocessor flame safeguard programmer with first out fault annunciation and diagnostic indicator lights. Furnish pre-purge and post-purge timing. Shut down burner in the event of ignition pilot and-or main flame failure with manual reset.
4. Full frontal access port shall be provided for the control area.
5. The boiler will be equipped with a non-sparking blower manufactured with a cast aluminum housing.
6. Combustion air pressure switch shall be provided.

#### C. Gas Train

1. Gas train shall be UL compliant.
2. The gas train shall be certified to take a maximum of 5 psi Natural Gas [2 psi Propane (LP)]. Additional step-down regulators are not allowed and can cause nuisance shutdowns of the unit.
3. Pilot and main gas pressure regulator.
4. Automatic main and redundant gas valves.
5. Leak test valves downstream of each gas valve.

6. Manual shut off valve upstream of burner and downstream of last gas valve.

#### D. Electrical Input

1. Electrical input to each boiler shall be as noted on the drawings. Single-point electrical hook-up on every unit is required; separate power wiring and control wiring is not acceptable.
2. The boilers must utilize a commercial quality 120v/1ph control system voltage. Coordinate with 15900.

#### E. Water Trim and Controls

1. ASME rated pressure relief valve set at 125 psig.
2. Combination water pressure and temperature gauge. Furnish graduated pressure gauge scale from 1½ to 3 times of pressure relief valve setting.
3. A water flow switch to prevent burner operation during low water flow conditions.
4. An adjustable high limit temperature controller with manual reset to prevent water temperature from exceeding a safe system temperature.
5. An adjustable operating controller.

#### F. Venting

1. Schedule 40 PVC.

#### G. Air Intake Piping

1. Schedule 40 PVC. Pipe must be at least the same size as the connection on the unit.

### 2.3 Performance:

- A. The boiler shall have a minimum of 94% thermal efficiency as listed in the Equipment Schedule of the Contract Documents.

### 2.4 Warranty:

- A. Boiler shall have the following warranties:

1. The heat exchanger shall carry a 10-year limited warranty.
2. The burner shall carry a 10-year limited warranty.

3. All other parts shall have a 2-year limited warranty.

### PART 3 - EXECUTION

#### 3.1 Boiler Installation:

- A. The Contractor is to inspect the boiler upon receipt of the unit and report any defects or problems to the Owner's representative.
- B. Install all external piping accessories and wiring as per manufacturer's requirements to form a complete installation.
- C. Provide factory startup and two (2) years warranty service (Fall inspection, testing, adjustments, parts, etc.).
- D. Interlock boiler burner and combustion air damper (see 15900).
- E. Contractor shall include State of Maryland fees associated with obtaining emission permit and inspection.

(END OF SECTION)

# SECTION 15700 - LIQUID HEAT TRANSFER

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Pumps.

### 1.2 Related Work:

- A. Section 15110 – Pipe and Pipe Fittings.
- B. Section 15120 – Valves, Cocks and Faucets.
- C. Section 15180 – Insulation.
- D. Section 15755 – Radiant Heat

### 1.3 Submittals:

- A. Submit shop drawings and product data.

## PART 2 - PRODUCTS

### 2.1 Circulating Pumps:

- A. Inline (Domestic Recirculating).
  - 1. Pumps shall be in-line type suitable for horizontal or vertical installation.
  - 2. The body shall be bronze cast iron, 175 psi working pressure with gauge, vent, and drain ports.
  - 3. Impeller shall be of non-ferrous material, enclosed type, dynamically balanced and keyed to shaft.
  - 4. Seals shall be an internally-flushed mechanical seal with ceramic seat suitable for continuous operation at 225 degrees F.
  - 5. Pumps shall be Bell and Gossett or approved equal by Amtrol/Thrush, TACO, or Armstrong.

## PART 3 - EXECUTION

### 3.1 Installation:

- A. Install equipment in accordance with the manufacturer's recommendations.

3.2 Water Balancing:

- A. The water distribution system shall be tested, adjusted and balanced to the quantities indicated on the contract document.

(END OF SECTION)



# SECTION 15755 - RADIANT SLAB HEATING SYSTEM

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Furnish and install all materials and perform all labor necessary for the complete installation of a radiant slab heating system as shown on the plans and specified herein, to provide a complete functional system.
  - 1. Manifolds.
  - 2. Tubing.
  - 3. Zone Pumps. (15700)

### 1.2 Related Work:

- A. Section 15010 - General Mechanical.
- B. Division 3 - Concrete.

### 1.3 Standards:

- A. ASTM.

### 1.4 Shop Drawings:

- A. Submit for approval shop drawings showing complete details for installation of the radiant slab heating system including layout drawings, manifolds and system schematic.

### 1.5 Warranty:

- A. Tube shall carry a 25 year warranty non-prorated warranty against failure due to defect in material and workmanship.

## PART 2 - PRODUCTS

### 2.1 Tube:

- A. Tube shall be cross-linked polyethylene, with maximum working pressure/temperature of 160 psi @ 73.4°F, 100 psi @ 180°F, 80 psi @ 200°F. These temperatures and pressure ratings shall be issued by hydrostatic stress board of PPI (Plastic Pipe Institute). PPI is a division of SPI (Society of Plastics Industry).
- B. The tube shall be manufactured in accordance with ASTM standard specification

F 876. The tube shall be listed to ASTM by independent third party testing laboratory.

- C. The tube shall be of cross-linked polyethylene manufactured by the “Engel Method”. The tube shall have an oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than .10g/m<sup>3</sup>/day @ 104°F water temperature.
- D. The minimum bend radius for cold bending of the tube shall not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by the tube manufacturer.

## 2.2 Manifolds:

- A. Manifolds shall be of cast brass construction, manufactured of alloys to prevent dezincification, and shall have integral circuit balancing valves. Manifolds shall be able to vent air from the system, and shall be provided with support brackets and tube bend supports. Manifolds shall be isolated from supply and return tubing with valves that are suitable for isolation and balancing.

## 2.3 Fittings:

- A. Fittings shall be manufactured of dezincification resistant brass. These fittings must be supplied by the tube manufacturer. The fittings shall consist of a compression fitting with insert, compression ring and a compression nut.

## 2.4 Supply and Return Piping to Manifolds:

- A. Piping shall be metal pipe or cross-linked polyethylene tube with an integral oxygen diffusion barrier. Cross-linked polyethylene tube should only be used when specifically approved by the local building inspector for supply and return piping applications.
- B. Fittings shall be compatible to the piping material used. Fittings used with the cross-linked polyethylene tube shall not permit excessive oxygen permeation.

## 2.5 Manufacturer: System shall be Uponor or approved equal by Rehau.

## PART 3 - EXECUTION

- 3.1 Hydronic radiant heat tubing loops shall be installed in accordance with the manufacturer’s recommendations and the details as shown on the contract drawings.
- 3.2 All fittings should be accessible for maintenance. Tubing loops shall be installed without splices, as a minimum, from the point at which the tubing enters the panel to the point at which it exits the panel.
- 3.3 Installation shall follow the shop drawings for tubing layout, tube spacing, manifold

configuration, manifold location, and controls. All notes on the drawing shall be followed.

- 3.4 The tubing system shall be pressurized, with water or air, in accordance with applicable codes, or to a pressure of 60 psig 24 hours prior to encasement in the radiant panel. The tubing system shall remain at this pressure during the panel installation, and for a minimum of 24 hours thereafter to ensure system integrity. The contractor shall provide the water or air for the pressurization of the tubing system. The contractor assumes all liabilities for suitable safety precautions and testing, including the use of compressed air, when applicable.
- 3.5 At start up time, the contractor shall:
- A. Follow the manufacturer's recommendations for system water and temperature balancing.
  - B. Record balance settings at each manifold location.
  - C. Deliver to the Owner a complete record of these settings for inclusion in the "Operation and Maintenance" Manuals.

(END OF SECTION)

# SECTION 15840 - ELECTRIC HEATERS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Electric Wall Heaters.

### 1.2 Related Work:

- A. Division 16 - Electrical.
- B. Section 15900 - Automatic Temperature Controls.

### 1.3 Standard:

- A. National Electric Code.
- B. UL.

### 1.4 Submittals:

- A. Submit detailed shop drawings.

## PART 2 - PRODUCTS

### 2.1 General:

- A. All electric heating units shall be UL listed.
- B. The capacity and type of unit shall be as scheduled on the drawings.

### 2.2 Electric Wall Heaters:

- A. Casing shall be of heavy gauge steel construction with 16 gauge grille and 20 gauge housing. Unit shall be as scheduled on the Drawings.
- B. The thermostat shall be unit-mounted. Provide rough-in box or surface mount as required.
- C. Unit shall be manufactured by Q-Mark or approved equal by Markel, Raywall or Redd-I.

## PART 3 - EXECUTION

### 3.1 Installation:

- A. Install as shown on the plans. Protect the entire unit during construction. Install

unit in accordance with the manufacturer's recommendations.

3.2 Cleaning:

- A. Before putting in operation, the entire unit shall be cleaned, including coils, and any damage repaired with a satisfactory finish.

(END OF SECTION)

# INSECTION 15850 - DUCTWORK

## PART 1 – GENERAL

### 1.1 Work Included:

- A. Sheetmetal Ductwork.
- B. Duct Accessories.
- C. Gas Vent.
- D. Louvers.
- E. Air Balance.

### 1.2 Related Work:

- A. Section 15860 - Exhaust Fans.
- B. Section 15190 - Duct Insulation.

### 1.3 Quality Assurance:

- A. SMACNA Duct Manuals and ASHRAE Handbooks.
- B. NFPA 90A,B and 96.

### 1.4 Submittals:

- A. Submit shop drawings and product data.

## PART 2 - PRODUCTS

### 2.1 Ductwork:

- A. Sheetmetal.
  - 1. Sheet aluminum - Soft temper, satin finish.
  - 2. Galvanized - Hot-dipped galvanized sheet steel A527.
  - 3. Weights and gauges - In accordance with SMACNA Duct Manuals and ASHRAE Handbooks.
  - 4.
- B. Insulated Flexible Air Duct (R-6)(Duct Inside the Building Insulation):
  - 1. Insulated flexible duct shall consist of a spiral polyester core liner with

galvanized helix. Insulation shall be 2", 0.75 PCF fiberglass blanket R = 6.0) with a flame resistant aluminized reinforced vapor barrier.

2. Ducts shall be UL 181 Listed Class 1 having a maximum flame spread of 25 and maximum smoke developed of 50.
3. Length of insulated flexible duct shall not exceed four feet.
4. Insulated flexible duct shall be ATCO #076 or approved equal by Genflex or Hart & Cooley.

C. Insulated Flexible Air Duct (R-8)(Duct Outside the Building Insulation):

1. Insulated flexible duct shall consist of a spiral polyester core liner with galvanized helix. Insulation shall be 3", 0.75 PCF fiberglass blanket R = 8.0) with a flame resistant aluminized reinforced vapor barrier.
2. Ducts shall be UL 181 Listed Class 1 having a maximum flame spread of 25 and maximum smoke developed of 50.
3. Length of insulated flexible duct shall not exceed four feet.
4. Insulated flexible duct shall be ATCO #078 or approved equal by Genflex or Hart & Cooley.

2.2 Flexible Connections:

- A. Specification grade neoprene coated 30 oz./square yard canvas fastened to 24 gauge galvanized sheet steel. Durodyne Model MFN-100 or approved equal by Ventfabrics or Ductmate Industries.

2.3 Volume Dampers (Manual Balancing):

A. General.

1. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressures to 1.0 in. wg (.25 kPa), velocities to 2000 fpm (10.2 m/s) and temperatures to 180<sup>0</sup> F (82<sup>0</sup>C). Testing and ratings to be in accordance with AMCA Standard 500-D.

B. Rectangular Duct.

1. Single Blade: Volume dampers less than 10" in height shall be single blade.
  - a. Dampers shall consist of: a 18 gauge. (1.3mm) galvanized steel frame with 3 ½ inch (89mm) depth; blades fabricated from 20 gauge (1mm) galvanized steel; integral ½ inch (13mm) diameter axles.

- b. Damper shall be Greenheck model MBD-10 or approved equal by Ruskin, Pottorff, Air Balance or American Warming and Ventilating.
  - 2. Multiple Blade: Volume dampers 10" and greater in height shall be multiple blade.
    - a. Dampers shall consist of a 16 gauge (1.5mm) galvanized steel hat channel frame with 5 inch (127mm) depth; triple V type blades fabrication from 16 gauge (1.5mm) galvanized steel; ½ inch (12mm) diameter plated steel axles; external (out of the airstream) blade-to-blade linkage.
    - b. Damper shall be Greenheck model MBD-15 or approved equal by Ruskin, Pottorff, Air Balance or American Warming and Ventilating.
- C. Round Duct.
  - 1. Round Blade:
    - a. Dampers shall consist of a 20 gauge (1mm) galvanized steel frame with 6 3/8 inch (162mm) depth; blades fabricated from 20 gauge (1mm) galvanized steel; 3/8 inch (10mm) square plated steel axles, acetal bearings.
    - b. Damper shall be Greenheck model MBDR-50 or approved equal by Ruskin, Pottorff, Air Balance or American Warming and Ventilating.

#### 2.4 Volume Damper Hardware:

- A. Rectangular Volume Dampers with standoff bracket for ductwork with external insulation- Ventlok 555 or approved equal by Young Regulator or Greenheck.
- B. Round Volume Damper with standoff bracket for ductwork with external insulation - Ventlok 555 or approved equal by Young Regulator or Greenheck.

#### 2.5 Gas Vent (90% + systems):

- A. PVC plastic drainage Schedule 40 DWV with PVC drainage fittings, ANSI/ASTM D-2665, D-1784.
- B. System shall include round pipe, termination kits and other appurtenances/accessories as required.
- C. Vent shall be rated and installed in accordance with UL, NFPA and the manufacturer's guidelines.



2.6 Access Doors, Ductwork:

A. General.

1. Hinged access doors in ductwork shall be provided before and after all coils and all fire or automatic dampers to allow complete access for maintenance. Doors shall be 12 inches by 12 inches or as large as duct size permits. Provide latches for fastening doors. Doors may be shop made or factory made.

2.7 Louvers - Stationary:

A. General.

1. Units shall be certified in accordance with AMCA Certified Rating Program for water penetration and air performance.
2. Louvers shall be of the stationary type and constructed of extruded aluminum finished as directed by the Architect.

B. Frames.

1. Units shall be 6" in depth and length and width as shown on the drawings.
2. Provide caulking slots.

C. Blades.

1. Blades shall be set at 37 degrees and approximately 5" on centers.

D. Miscellaneous.

1. Provide insect screens.
2. Provide extended sill.

E. Unit shall be manufactured by Ruskin ELF 6375DX or approved equal by American Warming and Ventilating, Airbalance, Louvers and Dampers, Greenheck or NCA or United Enertech.

2.8 Brick Vent:

A. General.

1. Brick vents shall be of the stationary type and constructed of aluminum finished as directed by the architect.
2. Unit shall be 4 inches deep.

3. Provide an aluminum mesh insect screen.
4. Unit shall be model "EX" as manufactured by Sunvent Industries or approved equal.

### PART 3 - EXECUTION

#### 3.1 General:

- A. Duct sizes shown are net. Increase duct sizes as required to account for duct liner to maintain free area.
- B. Install products in accordance with the manufacturer's recommendations.

#### 3.2 Ductwork:

- A. Fabricate and install all ducts and plenums in accordance with the ASHRAE Guide and the appropriate SMACNA Duct Manual.
- B. Seal all duct joints with mastic duct sealer. Tape shall not be used for duct sealer.
- C. Flex duct shall be range from minimum 4 linear feet to maximum of 6 linear feet.

#### 3.3 Gas Vent (90% + systems):

- A. Install the gas vent in accordance with the manufacturer's recommendations.
- B. Form solvent joints in PVC pipe and fittings to ANSI/ASTM D-2855.
- C. Cut pipe square and clean surfaces to be joined. Provide cleaning solvent and primer prior to cementing. Apply cement & cleaning solvent to both surfaces and turn the pipe slightly while inserting to assure even distribution.

#### 3.4 Air Balance:

- A. The air distribution system shall be tested, adjusted and balanced to the quantities indicated on the contract document.
- B. The Contractor shall obtain the services of an independent test and balance agency that specializes in and whose business is limited to the testing and balancing of air conditioning systems. The agency selected shall be fully certified by the Associated Air Balance Council (AABC), or the National Environmental Balancing Bureau (NEBB). The agency shall submit qualifications to the Engineer for approval prior to commencing any work on this project. All final reports shall be signed by an AABC Test and Balance Engineer or a NEBB Certified Supervisor and shall include an official stamp.

- C. Testing and balancing shall be performed in complete accordance with current AABC National Standards for Field Measurement and Instrumentation, or NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems applicable to air distribution.
- D. Instruments used for testing and balancing of air systems must have been calibrated within a period of six months and checked for accuracy prior to start of work. Provide a list of instruments used on the project to include all serial and model numbers and calibration dates.
- E. Six (6) copies of the complete test report shall be submitted to Engineer prior to final acceptance of the project.
- F. The approved balancing agency shall monitor job progress during installation phase of contract to assure dampers, etc. are installed as shown or specified.
- G. The Contractor shall submit name of the test and balance agency to the Architect and Consulting Mechanical Engineer for approval within thirty (30) days after receipt of construction contract by the air conditioning contractor. If the Contractor fails to submit the name of the selected test and balance agency with the above prescribed period, the Consulting Mechanical Engineer may select the certified AABC or NEBB agency of his choice and Contractor must then insure purchase order for this work as directed and assume all costs.
- H. The Contractor shall demonstrate a minimum of 5% random sampling to the Engineer/Owner during the system demonstrations. Demonstrations shall confirm the air balance report readings.

(END OF SECTION)

# SECTION 15851 – Zone Dampers

## PART 1 – GENERAL

### 1.1 Work Included:

- A. Zone Damper System.

### 1.2 Related Work:

- A. Section 15850 – Ductwork.
- B. Section 15870 – Packaged Equipment
- C. Section 15900 – Automatic Temperature Controls

### 1.3 Quality Assurance:

- A. SMACNA Duct Manuals and ASHRAE Handbooks.
- B. NFPA 90A,B and 96.

### 1.4 Submittals:

- A. Submit shop drawings and product data.

## PART 2 - PRODUCTS

### 2.1 Zone Damper System (WattMaster):

- A. System Description.

- 1. The control system shall be a microprocessor based, stand alone system capable of controlling up to 30 zoned HVAC units. Each HVAC unit shall support up to 16 individual zones. In addition to zone control, system shall be capable of controlling up to 390 single zone constant volume units all connected to the same communications network. A central operator's interface panel with a keypad and display shall allow the programming of all setpoint parameters and time scheduling for all controllers without the use of a personal computer. All devices shall be powered by 24 volts AC. All field wiring shall be NEC Class II. The system shall include a communications interface for the purpose of both local and/or remote communications with a personal computer. System shall be Auto-Zone Plus by WattMaster or approved equal by Honeywell or Varitac by Trane.

- B. Warranty:

- 1. The control system shall have a one-year manufacturer's limited warranty from date of installation.

2. Contractor shall have successfully completed the factory approved course for the zone damper system. Contractor shall submit course completion certificate prior to submitting zone damper submittal.

C. Communications.

1. The control systems communication shall be RS-485/9,200 baud, HSI Open Protocol, Token passing network. Manufacturer must be able to provide a copy of communications protocol if requested without additional cost.

D. Operator Interface Panel.

1. A central operators panel shall be provided. All controllers connected to the network shall be accessed from one operator's panel. All system values and setpoints shall be accessible for viewing and modification through this interface panel. The interface shall consist of a membrane keypad for the purpose of data entry. The operator interface shall have a 4 line by 20 character, backlighted, LCD display for the purpose of displaying system status, values, setpoints, alarms, and error messages. The display must show data with English descriptors. Special code or cryptic messages will not be acceptable. Interface must provide password protection to protect data from non-authorized users.

E. Zoned HVAC Unit Controller.

1. Zoned HVAC central units shall be controlled by a master controller. The master controller will be responsible for monitoring each zone via information received from the zone controllers and in turn control the HVAC unit to satisfy the requirements for each individual zone. The master controller shall be powered with 24 vac and shall utilize quick-disconnect terminal blocks for all wiring connections. In case of power failure, the master controller shall be capable of storing system values and setpoints for up to ten days utilizing a non-battery memory back-up. Each master controller shall support up to 16 zone controllers.
2. The master controller shall provide Inputs for the following:
  - a. Outside Air Temperature Sensor
  - b. Supply Air Temperature Sensor
  - c. Return Air Temperature Sensor
  - d. Static Pressure Sensor for Bypass Control
  - e. Bypass Damper Actuator Feedback
  - f. Economizer Disable
  - g. Force Occupied Modes
  - h. Change Filter Status
3. Controller shall provide Outputs for the following:

- a. Fan
  - b. Heating - 2 Stages (Expandable to 6)
  - c. Cooling - 2 Stages (Expandable to 6)
  - d. Bypass Actuator (Modulating)
  - e. Exhaust Fan/Relief Damper
  - f. Modulating Economizer Damper (0-10 vdc)
4. The master controller will provide the following control functions:
- a. 7 Time of Day Scheduling
  - b. 365 Day holiday Scheduling
  - c. Fan Control - Continuous or Cycling
  - d. Static Pressure Control
  - e. Zone Voting Status
  - f. Minimum Heating/Cooling Lockouts
  - g. Minimum Heating/Cooling Runtime
  - h. Minimum Heating/Cooling Off Time
  - i. Heating/Cooling Change Over Delay
  - j. Supply Air Setpoint for Economizer Control
  - k. Modulating Economizer Control
  - l. Economizer Enable Setpoint
  - m. Minimum Economizer Position
  - n. Automatic Daylight Savings Time Adjustment - Automatic or Manual
5. The following status values from the master controller shall be accessible from the operators interface panel:
- a. Supply, Return, & Outside Air Temperatures
  - b. Static Pressure
  - c. Bypass & Economizer Position Feedback
  - d. Total System Heating and Cooling Demand
  - e. Heating/Cooling Priorities
  - f. Mode Status
  - g. Heating/Cooling Lockout Status
  - h. Alarm Status
  - i. Software Version Installed
6. The following alarm values from the master controller shall be accessible from the operators interface:
- a. Bad Supply Air Sensor
  - b. Supply Air Temperature Alarm
  - c. Static Pressure Failure
  - d. Damper Failure
  - e. Missing Zone
  - f. Zone out of Setpoint Range for over 1 Hour
  - g. Change Filter alarm

- h. Bad Zone Sensor
  - i. Zone Damper Failure
7. The master controller shall be capable of storing trend logs for all input points. External storage devices will not be acceptable. These logs shall be accessible locally or remotely using a Windows based software package which shall be provided with the system.

F. Zone Controllers

1. All zone controller shall be microprocessor based and monitor space temperature to allocate proper air flow into its zone to achieve the desired comfort and ventilation levels. Both pressure dependent and independent control shall be possible from the same controller. The zone controller shall be powered by 24 vac and shall utilize quick-disconnect terminal blocks for all wiring connections. Zone damper, air flow sensor (Pressure Independent only), and auxiliary relay board wiring ,shall be performed using modular, plug-in connectors. Auxiliary relay boards shall be provided if control of base board heat, box heat, series fan, or parallel fan control is required.
2. Zone Controller shall provide inputs for the following:
  - a. Room Sensor
  - b. Room Sensor Setpoint Adjustment
  - c. Zone Damper Actuator Feedback Signal
  - d. Air Flow Sensor (Pressure Independent Only)
3. Zone Controller shall provide outputs for the following:
  - a. Zone Damper Actuator (Modulating)
  - b. Auxiliary Relay Board Expansion:
  - c.
    - (1) Baseboard Heat
    - (2) Box Heat
    - (3) Series Fan
    - (4) Parallel Fan
4. The zone controller will provide the following control functions:
  - a. Occupied/Unoccupied - Heating/Cooling Setpoints
  - b. Min/Max Zone Damper Position (Pressure Dependent)
  - c. Min/Max Zone Damper CFM (Pressure Independent)
  - d. Override Operation
  - e. Room Sensor Setpoint Adjustment Range
  - f. Voting/Nonvoting Status
  - g. Room Sensor Calibration Offset
  - h. Auxiliary Heat Setpoint
  - i. Trend Logging Interval

5. The following status values from the zone controller shall be accessible from the operators interface panel:
  - a. Room Temperature
  - b. Cooling & Heating Setpoint
  - c. Room Sensor Setpoint Adjustment Value
  - d. Heating/Cooling Demand
  - e. Zone Damper Position (True Feedback)
  - f. Airflow (Pressure Independent Only)
  - g. Current Damper Min/Max - Position/Airflow Setpoints
  - h. Current Duct Supply Temperature
  - i. Current HVAC unit Mode of Operation
  - j. Relay Expansion Board Status (If connected)
  - k. Voting Status
  - l. Force Mode Status
  - m. Calibration Status
  - n. Override Status
  - o. Alarm Status
  - p. Software Version Installed
  
6. The following alarm values from the zone controller shall be accessible from the operators interface panel:
  - a. Damper Calibration Failure
  - b. Damper Drive Open Failure
  - c. Damper Drive Close Failure
  - d. Zone Sensor Failure
  - e. Missing Zone
  - f. Zone out of Setpoint Range for over 1 Hour

G. Zone and Bypass Dampers.

1. Round dampers shall be provided with factory mounted controls. Controls and actuator shall be mounted inside a general purpose, galvanized steel enclosure mounted to the damper assembly. The enclosure shall have a removable cover.
2. Dampers shall be constructed from galvanized steel with damper mechanically fastened to a shaft and isolated from the casing to eliminate the possibility of damper binding due to shipping or handling damage. The damper shaft is to rotate in oil impregnated sintered bronze bearings. The unit casing shall be constructed of 22 gauge galvanized steel. The damper shaft shall have a mechanical position indicator of the damper position.
3. The damper blade shall be a sandwich construction incorporating a solid sheet of Volara, type A gasket material, sandwiched between two halves of reinforced galvanized steel. The average valve leakage of all units shall not exceed 1% at 3" inlet static pressure.



4. Zone Dampers for Pressure Independent operation must come with a factory mounted, averaging flow probe mounted at the inlet of the damper and solid state air flow sensor.
5. Each round damper shall be factory insulated. The insulation shall surround the outside of the damper. The insulation shall be a minimum of 1/2" thick, dual density fiberglass with a .001" aluminum foil face. The insulation must be UL listed and meet NFPA 90A requirements.
6. All performance data shall be ARI certified and rated in accordance with standard 880-89.

H. Single Zone Constant Volume Controller

1. Non-Zoned HVAC units shall be controlled by a microprocessor based Constant Volume Controller. The controller shall be a stand alone controller capable of communicating over an RS-485 network to the operators interface. The constant volume controller shall be powered by 24 vac and shall utilize quick-disconnect terminal blocks for all wiring connections. In case of power failure, the Constant Volume Controller shall be capable of storing system values and setpoints for up to ten days utilizing a non-battery memory back-up.
2. The constant volume controller shall provide Inputs for the following:
  - a. Room Temperature Sensor
  - b. Room Sensor Setpoint Adjustment
  - c. Supply Air Temperature Sensor
  - d. Change Filter Status
  - e. Outside Air Sensor (Only one required per system)
3. The constant volume controller shall provide Outputs for the following:
  - a. Fan
  - b. Heating/Cooling Relays - Software Configurable
  - c. Modulating Economizer Damper (0-10 vdc)
4. The constant volume controller shall provide the following control functions:
  - a. 7 Time of Day Scheduling
  - b. 365 Day Holiday Scheduling
  - c. Occupied/Unoccupied Heating Setpoint
  - d. Occupied/Unoccupied Cooling Setpoint
  - e. Room Sensor Slide Adjustment Range
  - f. Setpoint Deadband
  - g. Fan Control
  - h. Minimum Heating/Cooling Lockouts

- i. Minimum Heating/Cooling Runtime
- j. Minimum Heating/Cooling Off Time
- k. Heating/Cooling Staging Delay
- l. Heating/Cooling Change Over Delay
- m. Number of Heating/Cooling Stages
- n. Supply Air Setpoint for Economizer Control
- o. Modulating Economizer Control
- p. Economizer Enable Setpoint
- q. Minimum Economizer Position
- r. Space & Supply Sensor Offset calibration
- s. Automatic Daylight Savings Time Adjustment
- t. Trend Logging Interval (Requires PC software)

5. The following status values from the constant volume controller shall be accessible from the operators interface panel:

- a. Room Temperature
- b. Cooling & Heating Setpoint
- c. Room Sensor Setpoint Adjustment Value
- d. Supply Temperature
- e. Outside Air Temperature
- f. Economizer Damper Position
- g. Current HVAC unit Mode of Operation
- h. Relay Status
- i. Force Mode Status
- j. Override Status
- k. Alarm Status
- l. Software Version Installed

6. The following alarm values from the constant volume controller shall be accessible from the operators interface:

- a. Zone Sensor Temperature
- b. Bad Zone Sensor
- c. Bad Supply Air Sensor
- d. Supply Air Temperature
- e. Change Filter alarm

I. Zone & Bypass Actuators.

- 1. All zone and bypass damper actuators shall be direct coupled type with a minimum running torque of 35 in-lb. Actuators shall be a tri-state/floating type with true position resistance feedback. Actuators shall be rated for a minimum of two million cycles. Rotation shall be 90 degrees with a running time of one minute. Actuators shall be powered by 24 vac. All wiring termination's, power, control, & feedback, shall be made through a single modular plug connector. Actuator shall include a override clutch mechanism for manual adjustment.

J. Zone Sensors.

1. Zone sensors shall be a flush mount using an industry standard, Type III, 10K thermistor. Sensor accuracy shall be plus or minus 0.4 degrees Fahrenheit. Sensor shall be protected in such a way that internal wall temperature variances will not effect the sensor reading. Sensor shall be housed in an off-white, plastic enclosure. Sensor shall be configured as follows:
  - a. Sensor with Override & Setpoint Adjustment
2. If setpoint adjustment option is used, a user programmable value of plus or minus 0-5 degrees Fahrenheit can be entered for each individual controller. System shall be able to use any combination of the four sensor configurations.

K. Duct & Outside Air Sensors.

1. Duct and Outside Air sensors shall be industry standard, Type III, 10K thermistor. Sensor accuracy shall be plus or minus 0.4 degrees Fahrenheit. Duct sensors shall be a probe type with a minimum 8" length. Outside Air sensors shall be mounted in a weather protective enclosure and shall be mounted outside in a location where the sensor will not be affected by direct sun light. Roof mounting will not be acceptable.

L. PC/Modem Interface.

1. An interface device shall be provided to allow both a computer and modem connection to the system. The interface shall provide two serial port connections for connection to PC and modem. The interface shall also provide auto-dial out capability to a remote PC and auto-dial out to a pager when alarm conditions occur in the control system.

M. Software.

1. A Windows based, color graphics software package shall be provided to the end user, even if local or remote communications with a PC is not implemented with the initial installation of this system. Software shall be compatible with Microsoft Windows 3.1 or Windows 95. DOS or OS/2 operating systems will not be acceptable. A full functioning licensed copy of the software with a user manual shall be included along with a copy of the software. The software shall not be copy protected as to restrict its installation on multiple computers. The software shall provide the following features and functions:
  - a. Preprogrammed Status Screens for:
    - (1) Master Controller
    - (2) Zone Controller

- (3) Constant Volume Controller
- (4) Wetbulb/Economizer Module
- (5) System Summary

- b. Menu Driven, Fill in the blank Programming for all system values & setpoints
- c. User definable, English language descriptors for all controller locations
- d. User friendly setup for on site or remote communications
- e. Multiple Levels of Password Protection
- f. Alarm Auto-dial out to a pager
- g. Alarm Auto-dial out to a remote PC
- h. Remote connection setup for multiple building sites
- i. Custom Graphics Editor
- j. Trend Log Setup
- k. Automatic Trend Log Retrieval
- l. Download of Trend Logs to Excel Format Spreadsheets
- m. Fill in the Blank Schedule Programming
- n. Point & Click Programming of Holiday Schedules
- o. Automatic Air Balance Force Modes
- p. Diagnostic Counters
- q. Alarm Logging
- r. User Access Logging

N. Wetbulb/Economizer Control.

- 1. System shall be capable of adding a wetbulb/economizer module to the controller communications loop. This device will be used to enhance economizer performance. The module will broadcast an outside air wetbulb value to all controllers utilizing economizer control. The module shall accept a signal from a dry bulb outside air temperature sensor and a relative humidity transmitter. In turn the module will perform necessary calculations to determine the proper wetbulb value. The relative humidity transmitter must be a solid state device with an minimum accuracy of plus or minus 3%.

### PART 3 – EXECUTION

#### 3.1 Installation:

- A. The contractor shall furnish and install the control system, all materials, and programming for full operation in accordance with the manufacturer's recommended requirements and procedures. The installation shall be in compliance with the National Electric Code, Occupational safety and Health Act, and all applicable state and local building codes.

#### 3.2 Wiring:

- A. All wiring shall be low voltage and shall be in accordance with the National

Electrical Code and local electrical codes. All communications wire shall be 18 gauge twisted pair with foil shield and tinned drain wire. All control wire to zone thermostats shall be 18 gauge solid thermostat wire. All power wire shall be 18 gauge minimum to all damper control modules with 16 gauge minimum for all trunk lines. All wire will be sized to deliver 22 VAC minimum at all components at maximum system current rating. Power to all components within a single system shall be controlled by a single power on/off switch.

3.3 Start-Up and Test:

- A. By factory-trained service personnel.

3.4 Owner's Instructions:

- A. Upon completion of the work and acceptance by the Owner, factory representatives under direct employ of the temperature control subcontractor shall provide one (1) 2-hour (minimum) period of instruction to the Owner's operating personnel who have responsibility for the mechanical system. After the instruction period the contractor shall submit a log-in sheet with the name, company and job title of all persons in attendance. The log-in sheet shall also have the date, start time and stop time of the instructional period. A system instruction manual shall be provided to the building operating personnel.

(END OF SECTION)

# SECTION 15860 – EXHAUST FANS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Ceiling Exhaust Fan.

### 1.2 Related Work:

- A. Section 15850 - Ductwork.
- B. Section 15900 - ATC.
- C. Division 16 - Electrical.

### 1.3 Quality Assurance:

- A. All fans shall bear AMCA seal for air and sound.
- B. All fans shall be UL labeled.

### 1.4 Submittals:

- A. Submit shop drawings.
- B. Submit installation instructions.
- C. Submit fan curves or AMCA certified performance table.

## PART 2 - PRODUCTS

### 2.1 General:

- A. Provide fans as scheduled on the Drawings.

### 2.2 Ceiling Exhaust Fan:

- A. Provide a ceiling exhaust fan with steel housing, BDD, disconnect, centrifugal blower, fan speed controller, ½" acoustic insulation and integral grille.
- B. Unit to be Soler & Palau or approved equal by Acme, Penn, Greenheck or Cook.

## PART 3 - EXECUTION

### 3.1 Installation:

- A. Install fans in accordance with the manufacturer's recommendations.

(END OF SECTION)

# SECTION 15870 - PACKAGED EQUIPMENT

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Split System Heat Pump.

### 1.2 Related Work:

- A. Section 15850 - Ductwork.
- B. Section 15900 – Automatic Temperature Controls.
- C. Section 15400 - Plumbing.
- D. Division 16 - Electrical.

### 1.3 Submittals:

- A. Submit shop drawings and product data.
- B. Submit manufacturer's installation instructions.
- C. Submit manufacturer's descriptive literature, operating instructions and maintenance and repair data.

### 1.4 Warranty:

- A. Provide an additional 4 year unconditional parts warranty on compressors.
- B. Provide an additional 9 year unconditional parts warranty on the heat exchanger.

## PART 2 - PRODUCTS

### 2.1 Manufacturer:

- A. Units shall be products of a manufacturer who provides local service personnel from factory representative, franchised dealer or certified maintenance service shop.

### 2.2 Split System Heat Pump Unit (2-stage):

- A. General.
  - 1. Unit shall be as scheduled on the drawings.
  - 2. Unit shall be rated in accordance with ARI Standards.

3. Coils shall be factory-assembled, piped, internally wired and fully charged with R-410a.
- B. Casing.
1. Unit shall be constructed of 20 gauge steel, cleaned, phosphatized coated with a baked enamel finish.
  2. Provide access doors for controls, filters, etc.
  3. Housing shall be insulated.
- C. Refrigeration System.
1. Unit complete with a hermetic sealed scroll 2-stage compressor. Compressor complete with reversing valve, crankcase heater, over temperature, current and pressure protection.
- D. Coils.
1. Copper tubing 3/8" O.C. seamless, mechanically bonded to aluminum fins.
  2. Coils shall be factory tested to 610 psig.
- E. Fans.
1. Condenser - Direct drive, propeller type, statically and dynamically balanced, UL listed with built-in overload protection.
  2. Evaporator – Direct driven, forward curved, centrifugal type Electronically Communicating Motor. Motor UL listed with built-in overload protection.
- F. Filters.
1. Provide filter rack with 1" throwaway type filters and a spare set.
- G. Electric Heaters.
1. Elements shall be heavy-duty nickel chromium with individual fuses and high limit controls.
  2. Heater shall be slide-in type.
- H. Indoor Thermostat.
1. Provided under section 15871.



- I. Manufacturer.
  - 1. Unit shall be York or approved equal by Carrier, Lennox, McQuay, or Trane.

### PART 3 - EXECUTION

#### 3.1 General:

- A. Install equipment in accordance with the manufacturer's recommendations.

#### 3.2 Split System Heat Pump Units:

- A. Provide factory approved refrigerant piping schematic for approval prior to fabrication.

#### 3.3 Filters:

- A. Contractor shall provide temporary filters during testing phase. A clean set of filters shall be installed at substantial completion and spare set shall be turned over at this time.

(END OF SECTION)

# SECTION 15880 - REGISTERS, GRILLES AND DIFFUSERS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Diffusers.
- B. Registers.
- C. Grilles.

### 1.2 Related Work:

- A. Section 15850 - Ductwork.

### 1.3 Submittals:

- A. Submit product data and shop drawings covering each item together with a schedule of outlets.

### 1.4 Quality Assurance:

- A. Rate outlets in accordance with ADC standards.
- B. Outlets shall have a maximum noise level of NC35.

## PART 2 - PRODUCTS

### 2.1 General:

- A. Supply outlets shall be complete with anti-smudge frames.
- B. Provide plaster frames for outlets located on plaster surfaces.

### 2.2 Diffusers:

- A. Ceiling (Louvered).
  - 1. Diffuser shall be finished in white enamel with snap in direction cores and factory square to round.
  - 2. Diffuser to be of steel or aluminum construction as shown on drawings.
  - 3. Unit to be square or rectangular with blow pattern as shown on drawings.
  - 4. Unit to be Titus or approved equal by Carnes, Krueger, E.H. Price or Metal Aire.

### 2.3 Registers:

#### A. Supply (Double Deflection).

1. Registers to be of steel construction, finished in white enamel.
2. Double deflection with adjustable horizontal face bars on  $\frac{3}{4}$ " spacing .
3. Unit with integral dampers.
4. Unit to be Titus or approved equal by Carnes, Metal Aire, Krueger, or E.H. Price.

### 2.4 Grilles:

#### A. Return (Sight Proof)

1. Grilles shall be  $\frac{1}{2}$ " x  $\frac{1}{2}$ " x  $\frac{1}{2}$ " aluminum grid with no flange border suitable for 2x2 lay-in ceiling or surface mount as shown on drawings.
2. Eggcrate grid shall be set at 45 degree angle that prevents line of sight through the grille.
3. Unit shall be Titus or approved equal by Carnes, Kreuger, E.H. Price or Metal Aire.

#### B. Transfer (Sight Proof)

1. Grilles shall be  $\frac{1}{2}$ " x  $\frac{1}{2}$ " x  $\frac{1}{2}$ " aluminum grid with no flange border suitable for 2x2 lay-in ceiling or surface mount as shown on drawings.
2. Eggcrate grid shall be set at 45 degree angle that prevents line of sight through the grille.
3. Unit shall be Titus or approved equal by Carnes, Kreuger, E.H. Price or Metal Aire.

## PART 3 - EXECUTION

### 3.1 Installation:

- A. Install items in accordance with the manufacturer's printed instructions.
- B. Paint ductwork, visible behind air outlets, matt black.

(END OF SECTION)

# SECTION 15900 - AUTOMATIC TEMPERATURE CONTROLS

## PART 1 - GENERAL

### 1.1 Work Included:

- A. Complete System of Automatic Controls.
- B. Control Devices, Components, Wiring and Material.
- C. Instructions to Owner.

### 1.2 Related Work:

- A. Section 15850 - Ductwork.
- B. Section 15851 – Zone Damper System.
- C. Division 16 - Electrical.

### 1.3 Submittals:

- A. Submit detailed shop drawings.
- B. Provide to the Engineer, descriptive literature for all temperature control equipment to be supplied for this project, accompanied by shop drawings which show the equipment's installed location, system connection and setpoint. At the completion of the project, provide as-built diagrams, matted for stiffness, enclosed in full sized, clear plastic envelopes. Envelopes to be wall-mounted, using hooks and grommets so as to be readily removable. In addition, furnish a complete set of component descriptive literature and 3 copies of bound operators manuals. The manuals shall consist of standard manufacturer's operating instructions for the control components accompanied by a custom set of operating and maintenance instructions specifically written for this project.

## PART 2 - PRODUCTS

### 2.1 Wiring:

- A. All line and low voltage wiring shall conform to the electrical specifications and the National Electric Code.
- B. All ATC wiring and located in concealed ceilings and walls shall be plenum rated. All exposed ATC wiring and ATC wiring in Mechanical/Electrical Rooms shall be installed in electric metallic tubing (EMT). The EMT installation shall be compliant with Section 16100.

### 2.2 Dampers:

- A. Frame, blades and baffles fabricated of steel with corrosion resistant, galvanized

finish. All dampers are provided with oilite bearings, stainless steel spring side seals, teflon coated stainless steel thrust washers and zinc plated hardware as standard.

- B. Blades shall have neoprene edging for fresh air and exhaust air applications.
- C. Modulating dampers shall have opposed-action blades.

### 2.3 Damper and Valve Operators and Linkages:

#### A. Operators.

- 1. Modulating low voltage motor type, 50% more power than minimum required to operate the valve or damper. Arrange to fail safe in the event of power failure.

#### B. Linkages.

- 1. Adjustable in length, pin and clevis or ball and socket type joints, free of excessive play.

### 2.4 Control Valves:

- A. All modulating control valves shall be equipped with throttling plugs with renewable composition discs. Valves shall be sized by the control manufacturer for the intended service. Provide factory certified CV valves for circuit and by-pass flows of mixing and straight through valves to the Engineer for approval.

### 2.5 Relays:

- A. Positive or gradual acting type shall be furnished as required to complete the specified control sequences.

### 2.6 Switches:

- A. Positive and gradual acting with suitable indicating nameplates.

### 2.7 Panels:

- A. Control panel(s) shall be fully enclosed cabinet, all steel construction and shall meet the requirements for a NEMA 1 enclosures. Cabinet shall have a hinged door with a locking latch. All cabinet locks shall use a common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Cabinet shall be finished with two coats of baked enamel paint. Panel shall be wall-mounted type and located where indicated on the mechanical drawings. All switches that are manually adjusted during routine operation of the system shall be located on the cabinet door with proper name tags. All other appurtenances shall be located within the cabinet.

### 2.8 Thermostats:

- A. In-floor Radiant Heating Room thermostats shall be furnished under this section. Thermostats shall have concealed adjustment and shall be furnished without thermometers and shall have the option to be password protected. Thermostats shall be provided with LCD screen and shall be suitable for in-floor radiant heating systems.
- B. Thermostats for Zone Damper system shall be provided under division 15851.

2.9 Miscellaneous:

- A. Transformers.
  - 1. Line to low voltage type, totally enclosed, fuse protection on both primary and secondary windings.
- B. Freezestat shall be manual reset line voltage (120/240) type complete with twenty foot non averaging sensing element. A drop in temperature below the freeze stat setpoint over any one foot section of the sensing element shall actuate the freezestat. The element shall be installed properly within the air handling unit to protect the water coil.

PART 3 - EXECUTION

3.1 General:

- A. Provide a complete system of automatic temperature controls as specified hereinafter and as shown on the Contract Drawings.
- B. The temperature control system shall be completely installed by mechanics and electricians either in the direct employ or under the direct supervision of the temperature control contractor.
- C. The temperature control subcontractor shall be responsible for and perform all temperature control wiring including all necessary interlock wiring required for a complete working system. Wiring shall be installed in accordance with the electrical section of these specifications.
- D. The control system shall consist of all thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, P.E. and E.P. switches, control panels, compressed wire supply, accessory control equipment and a complete system of air piping to fill the intent of the Specification and provide for a complete and operable system.

3.2 Connections:

- A. Electric or Electronic.
  - 1. Connections to switches, thermostats, valves, etc., shall be made with screws or insulated spade type connectors. Push-in connections at devices

will not be allowed.

3.3 Identification:

- A. All devices shall be labeled as approved by the Engineer.

3.4 Owner's Instructions:

- A. Upon completion of the work and acceptance by the Owner, factory representatives under direct employ of the temperature control subcontractor shall provide two 4-hour periods of instruction to the Owner's operating personnel who have responsibility for the mechanical system. One 4-hour session shall be performed during the heating season and the other session shall be held during the cooling season.

3.5 Sequence of Operation:

- A. General Description of Operating Zones.

- 1. One 7 day time clock shall index all systems between occupied and unoccupied cycles of operation. Provided manual override switches for each air handling unit. Each switch shall be marked "Clock - Occupied - Unoccupied".

- B. Split System Heat Pump Control:

- 1. General.

- a. Unit shall be switched between occupied and un-occupied modes by a programmable thermostat. Each system shall be provided with a means of manual override.

- 2. Occupied Cycle.

- a. General - During the occupied mode the supply fan shall run continuously and the OA damper shall be open to the minimum position.
- b. Heating – See heating coil sequence.
- c. Cooling – On a rise in temperature above the thermostat setpoint, the 1st-stage cooling of the compressor shall be energized. On a continued rise in space temperature the 2nd-stage cooling of the compressor shall be energized. On a fall in temperature the reverse shall occur.
- d. Dual Enthalpy Economizer(On a call for cooling) – When outdoor enthalpy conditions are suitable for natural cooling, the economizer cycle shall be enabled and the outside air damper and return air damper shall modulate to maintain a discharge

temperature of 55 degrees F (adjustable). When any system is 50% economizer or greater the associated relief air damper shall open. The reverse shall occur when the system economizer drops below 50%.

3. Unoccupied Cycle.

- a. General – During the un-occupied mode the supply fan shall cycle as needed to maintain the un-occupied heating/cooling set points and the OA damper shall be closed.
- b. Heating – Unit shall be off.
- c. Cooling - On a rise in temperature above thermostat setpoint, the cooling apparatus shall be energized. On a fall in temperature the reverse shall occur. When outdoor enthalpy conditions are suitable for natural cooling, the economizer cycle shall be enabled.

C. Zone Damper System:

1. Heating - On a fall in temperature below the thermostat setpoint, the zone damper shall modulate to the maximum setpoint as scheduled on the plans. On a rise in temperature the zone damper shall modulate to the minimum setpoint as scheduled on the plans.
2. Cooling - On a rise in temperature above the thermostat setpoint, the zone damper shall modulate to the maximum setpoint as scheduled on the plans. On a fall in temperature the zone damper shall modulate to the minimum setpoint as scheduled on the plans.

D. Dehumidifier:

1. On a rise in space relative humidity above the humidistat setpoint the dehumidifier shall be energized. Upon a fall in space relative humidity below the humidistat setpoint the dehumidifier shall be de-energized.

E. Heating Water Control:

1. The boiler(s) shall be provided with all operating and safety controls factory installed and prewired by the boiler manufacturer. The boiler(s) shall be enabled when outdoor air temperature falls below 60 degrees F(adjustable) as sensed by an outdoor thermostat and shall be energized to maintain heating water loop temperature. Provide a lead/lag switch to alternate lead boiler operation.
2. Boiler heating water circulating pump(s) shall be enabled whenever the boilers are enabled. Provide a lead/lag switch to alternate lead pump operation.
3. When outdoor temperature falls below 60 degrees Fahrenheit (adjustable) as sensed by an outdoor thermostat, system heating water circulating



pump shall be energized.

4. Provide a system of indoor/outdoor reset control of a three way mixing control valve. The system shall vary the heating water supply temperature inversely with outdoor air temperature to meet the building heating demands. The controller shall have adjustable range and ratio settings as well as a manual override switch so the valve may be operated independent of the controller in an emergency.

F. In Floor Radiant Heating :

1. On a fall in temperature below the thermostat setpoint 68 degrees Fahrenheit (adjustable), the associated zone valve shall be energized. On a rise in temperature above the thermostat setpoint the reverse shall occur.

G. Heating Coil:

1. When the associated system is indexed to heating, the heating control valve shall modulate to maintain a supply air discharge temperature of 70 degrees Fahrenheit.
2. Provide a freezestat for heating coil protection. When freezestat trips the associated supply fan shall turn off and the outside air damper shall close.

H. Toilet Exhaust Fans:

1. Toilet exhaust fans shall be controlled by lighting controls.

I. Demonstration and Guarantee:

1. Upon completion of the installation of the control system by the control subcontractor, he shall demonstrate the entire automatic temperature control system to the engineer.
2. The automatic temperature control subcontractor shall guarantee the temperature control system against defects in workmanship and material for a period of one year which shall commence upon acceptance of the system by the Engineer. The control subcontractor shall provide the services of a factory trained service technician during the guarantee period within 24 hours should any portion of the control system fail to operate. In the event of a loss of heating, service shall be provided within 4 hours.
3. If any control component should fail as a result of faulty workmanship or material during the guarantee period, the control subcontractor shall replace it at no cost to the owner.

(END OF SECTION)