

**SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS:**

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section, and all sections of Division 15.

1.2 SCOPE:

- A. Provide all labor, material, tools, equipment and services necessary and incidental for installing all mechanical 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.

1.3 PERMITS AND FEES

- A. Obtain and pay for any permits, inspections, certificates, etc. required by the authorities having jurisdiction.

1.4 CODES AND REGULATIONS:

- A. All materials furnished and all work installed shall comply with the codes and regulations adopted by the State of Maryland and recommendations of the following bodies:
 - ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 - IBC - International Building Code
 - IMC - International Mechanical Code
 - IPC - International Plumbing Code
 - MOSHA - Maryland Occupational Safety and Health Administration
 - NEC - National Electrical Code
 - NEMA - National Electrical Manufacturers Association
 - NFPA - National Fire Protection Association
 - NSPC - National Standard Illustrated Plumbing Code
 - OSHA - Occupational Safety and Health Administration
 - UL - Underwriters' Laboratories
 - Fire Protection Bureau State of Maryland

1.5 EXISTING CONDITIONS:

- A. Prior to preparing the bid, the mechanical subcontractor shall visit the site and become familiar with all existing conditions. Make all necessary investigations as to locations of utilities and existing field conditions that could affect the work. No additional compensation will be made to the contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

1.6 CUTTING AND PATCHING:

- A. Cutting and patching associated with the work in the existing structure shall be performed in a neat and workmanlike manner. Existing surfaces that are damaged by the contractor shall be repaired or provided with new materials to match existing.
- B. Structural members shall not be cut or penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, non-percussive methods.
- C. Patching of areas disturbed by installation of new work and/or required demolition shall match existing adjacent surfaces as to material, texture and color.

1.7 OUTAGES:

- A. All mechanical and plumbing outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon with the Owner.
- B. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled with the Owner at least ten days (10) days in advance.
- C. The bid price shall include the cost of all premium time required for outages and other work which interferes with the normal use of the building.
- D. The operation of valves or switches required to achieve an outage shall be accomplished by the Owner. Unauthorized operation of valves, power switches, or other control devices shall not be permitted.

1.8 SUBMITTALS:

- A. General: Submit each item in this Section according to the conditions of the Contract.
- B. Shop Drawings and Product Data:
 - Clearly identify all submittals:
 - Indicate intended application, location, etc.
 - Each submittal shall indicate the associated specification section, and paragraphs. Do not combine product data and shop drawing submittals from different spec sections into a single submittal package, even though they may be the same distributor, vendor or part of a single material order.
 - Clearly indicate the exact type, model number, size and special features of the proposed item.
 - Include catalog spec sheets to completely describe proposed equipment.
 - Factory order forms only showing the required capacities are not acceptable.
 - Identify all options furnished to meet specifications.
 - If product is within system supplying plumbing fixture(s) intended to dispense potable water for human consumption, including drinking and cooling, submittals shall indicate that product is "lead free", containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
 - The Architect shall not select equipment ratings and/or options. Submittals not properly marked shall be returned without review.
- C. Closeout Submittals:
 - Prepare record documents. Maintain one copy on site. Record actual locations of valves, dampers and controls.
 - Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- D. Operational and Maintenance Manuals:
 - Provide three (3) sets of Operation and Maintenance manuals for materials and equipment installed in the project area included in Division 15. The Operation and Maintenance manuals shall include one copy of each approved submittal, approved TAB report, any manufacturers maintenance manuals, all warranty certificates, bound in a three ring binder with tabs for each submittal. Also include a list of each manufacturer with the address, phone number and contact person.

1.9 CONNECTIONS AND ALTERATIONS TO EXISTING WORK:

- A. When existing mechanical work is removed, all pipes, valves, ducts, etc. shall be removed back to the active pipe and duct mains and capped.

- B. Removal and/or relocation of existing services shall be closely coordinated with the user if they impact adjacent areas which shall remain operational.
- C. While performing connections and alterations to existing mechanical work, the contractor shall take extreme care to protect all existing materials, equipment, casework etc. from dirt, debris, and damage. Any damage caused by the contractor to existing materials, equipment, casework, etc. shall be repaired to the architect's satisfaction and specifications at the contractor's expense.

1.10 SLEEVES AND PLATES:

- A. Sleeves shall be provided by the trade installing the pipes which pass through floor slabs, concrete masonry, tile, and/or gypsum wall construction. In new construction all sleeves shall be carefully located in advance of the construction of walls, floors, etc. Provide sleeves for all new work which passes thru existing floors, walls etc. All sleeves shall be sized to accommodate pipe and/or duct and insulation where required. See sleeve detail on drawings.

1.11 FIRE STOPS & SMOKE SEALS:

- A. Provide fire stops and smoke seals for all mechanical services installed and existing services in the project area that pass through fire rated partitions, wall, floors etc. Services shall include all ductwork, conduit, metal and plastic piping, cables, etc. The area around penetrations including any voids between them must be filled in and sealed with UL fire rated materials equal to the adjoining materials. All fire stop insulation devices and sealants shall maintain the fire resistance integrity of the floor, wall partition, etc. and meet ASTM 814-83 F&T rating for time, hours and temperature rise. All fire stopping and sealants shall allow for expansion and contraction movement without pumping free of openings. Provide U. L. System Numbers in product submittals for each Fire Stop & Smoke Seal Application.

1.12 CLEAN-UP:

- A. Excessive debris and dirt, such as occurs from cutting through masonry or plaster walls shall be cleaned up from the equipment and removed immediately after the work of cutting through the walls.
- B. Debris shall be removed from the site.
- C. Ceiling panels shall be replaced as soon as work is finished in the area, and shall be kept free of dirty finger prints. Where work is being done in corridors used by patients and visitors, ceiling panels shall be replaced at the close of the day's work even if work is at the particular location is incomplete.
- D. All areas shall be left broom-clean at the end of the work period.

1.13 GUARANTEE:

- A. All materials, equipment, etc. provided by the general contractor and/or his subcontractor shall be guaranteed to be free from defects in workmanship and materials for a period of one (1) year after date of certificate of completion and acceptance of work by Architect. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the contractor without cost to the owner, within a reasonable time, to be specified by Architect. In default thereof, owner may have such work done and charge the cost of same to the contractor. In addition to the above statement the Guarantee Period shall include all labor cost related to all warranty work.

1.14 LISTED MANUFACTURERS:

- A. The manufacturers listed represent the basis for design and identify the minimum level of quality for materials and equipment, specified in this specification, that are acceptable to the Architect. Unless otherwise indicated in this specification, contractors may submit material and equipment by non listed manufacturers provided said submittals meet the requirements of these specifications. All submitted materials and equipment are subject to approval by the engineer and Architect.

1.15 VIBRATION ISOLATION

- A. Provide all mechanical equipment with suitable vibration Isolators so as to prevent transmissions of vibration into or through the building structure. Isolators shall be selected by the isolator manufacturer for each item or equipment in accordance with the item and/or equipment manufacturer's requirements. Select isolators for uniform static deflections according to distribution of weight and for not less than the manufacturers recommended isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment and shall be designed to resist horizontal forces of equipment which may operate unbalanced. In general, select isolators on the basis of criteria as specified in ASHRAE.
- B. All HVAC components mounted outside of the building envelope (on-grade, on roof, on exterior walls, etc.) shall be mounted and supported to resist wind loads as required by the International Building Code (IBC), edition in effect by local authority having jurisdiction.

1.16 ELECTRONIC CAD DOCUMENTS

- A. Requests for electronic CAD documents will be accommodated to the contractors and installers upon their completion of Kibart's Electronic Document Release of Liability Form and payment for time and expense for document preparation.
 - Kibart's document preparation fee is as follows:
 - Two hundred and fifty dollars (\$250.00) for the first five (5) drawings.
 - Fifty dollars (\$50.00) for each drawing thereafter.

1.17 QUALITY ASSURANCE

- A. All equipment containing electrical components provided under Division 15 shall bear the Underwriters Laboratory CUL label, as a complete package.
- B. Fire Safe Materials: Unless otherwise indicated, materials shall conform to UL, National Fire Protection Agency (NFPA) or American Society for Testing and Materials (ASTM) standards for fire safety with smoke and fire hazard rating not exceeding flume spread of 25 and smoke developed of 50.
- C. All plumbing products and materials shall be listed by a third party certification agency.

PART 2 PRODUCTS: Not Used

PART 3 EXECUTION: Not Used

END OF SECTION

**SECTION 15076
IDENTIFICATION FOR HVAC AND PLUMBING PIPING AND EQUIPMENT**

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, and all sections of Division 15.

1.2 REFERENCES

(Unless otherwise noted, references apply to "latest editions.")

- A. American Society of Mechanical Engineers:
 - ASME A13.1 - Scheme for the Identification of Piping Systems, 2007.
- B. National Fire Protection Association:
 - NFPA 99 - Standard for Health Care Facilities, 2005.

1.3 SUBMITTALS

- A. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Furnish copies for Maintenance Manuals.

1.4 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - ANSI Standards: Comply with ANSI A13.1, for lettering size, length of color field, colors, and viewing angles of identification devices.
- C. Equipment Lettering and Graphics:
 - General: Coordinate names, abbreviations and other designations used in HVAC identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of HVAC systems and equipment.
 - Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification, which indicates individual system number as well as service (for example; Unit Heater No. 3).

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering identification materials which may be incorporated in the work include, but are not limited to, the following:
 - Brady (W.H.) Co.; Signmark Div.
 - Industrial Safety Supply Co., Inc.
 - Seton Name Plate Corp.
- B. Manufacturer: Subject to compliance with requirements, provide HVAC identification materials of one of the following:
 - Brady (W.H.) Co.; Signmark Div.
 - Industrial Safety Supply Co., Inc.
 - Seton Name Plate Corp.

2.2 MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.
- B. Painted Identification Materials:
 - Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes not less than 1 1/4" high for ductwork and not less than 3/4" high for access door signs and similar operational instructions.
 - Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 - Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems and HVAC equipment comply with ANSI A13.1 for colors. For ductwork, use green paint. For hazardous exhaust, use colors per ANSI A13.1.
- C. Plastic Pipe Markers:
 - Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, UV-resistant color-coded pipe markers, complying with ANSI/ASME A13.1
 - Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - Adhesive lap joint in pipe marker overlap.
 - Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1 1/2".
 - Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length. Operating pressure of steam systems shall be indicated.
 - Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
 - Provide pipe markers with the following background colors and designations:

| Service | Stencil Designation | Letter Color | Background Color |
|----------------------|----------------------|--------------|------------------|
| Sanitary/Vent | Sanitary/Vent | White | Safety Green |
| Domestic Cold water | Domestic Cold water | White | Safety Green |
| Domestic Hot water | Domestic Hot water | White | Safety Green |
| Condensate drain | Condensate drain | White | Safety Green |
| Fuel oil Supply | Fuel oil Supply | White | Safety Brown |
| Fuel oil Return | Fuel oil Return | White | Safety Brown |
| Refrigerated Suction | Refrigerated Suction | Black | Safety Orange |
| Refrigerated Liquid | Refrigerated Liquid | Black | Safety Orange |

D. Valve Tags:

- 1. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - Provide 1 1/2" sq. black tags with white lettering, except as otherwise indicated.
 - Provide size, shape and color combination as specified or scheduled for each piping system.
- 2. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately

- 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
 - Provide 1 1/8" sq. white tags with black lettering.
 - Provide size, shape and color combination as specified or scheduled for each piping system.
- 3. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
- 4. Ceiling Grid and Access Panel Markers: Provide Kroy type clear adhesive printed labels with 3/16" high letters to identify the type of concealed HVAC devices.

E. Engraved Plastic-laminate Signs:

- 1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- 2. Thickness: 1/8", except as otherwise indicated.
- 3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- 4. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - Name and plan number.
 - Equipment service.
 - Design capacity.
 - Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- 5. Size: Provide approximate 2 1/2" x 4" markers for control devices, dampers, and valves; and 4 1/2" x 6" for equipment.

F. Plasticized Tags:

- 1. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 1/4" x 5 5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

G. Duct Markers:

- 1. Identify air: supply, return, exhaust, intake and relief ducts with duct markers or provide stenciled signs and arrows showing service and direction of air flow.
 - Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 25 feet.
 - Provide identification labels at access panels to locate concealed duct accessories.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION:

- A. General:
 - Coordination: Where identification is to be applied to surfaces, which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
 - Confined Spaces: Provide labels and signs on all duct and equipment doors, plenums, etc. to indicate service and provide operator warnings as required by OSHA, NFPA, and authority having jurisdiction.
- B. Piping System Identification:
 - General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - Plastic pipe markers, with application system as indicated under "Materials" in this section.
 - Locate pipe markers and color bands as follows on all piping in occupied spaces, above ceilings, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 - Near each valve and control device.
 - Near each branch, excluding short take-offs for equipment and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
 - At access doors, manholes and similar access points, which permit view of concealed piping.
 - Near major equipment items and other points of origination and termination.
 - Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 10' in congested areas.

C. Valve Identification:

- 1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, and shut-off valves at HVAC equipment. List each tagged valve in valve schedule for each piping system.

D. Equipment Identification:

- 1. General: Install engraved plastic laminate sign on or near each major item of HVAC equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - Fuel-burning units.
- 2. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- 3. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety precautions, and warn of hazards and improper operations.

3.3 ADJUSTING:

- A. Adjusting: Relocate any identification device, which has become visually blocked by work of this division or other divisions.

3.4 CLEANING:

- A. Cleaning: Clean face of identification devices.

3.5 EXTRA STOCK:

- A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 - Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

**SECTION 15080
THERMAL INSULATION**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section, and all sections of Division 15.

1.2 SUMMARY

- A. All insulation shall be installed by a qualified insulation contractor. Insulation installed on cold surfaces shall have a vapor barrier and exposed ends shall be sealed. All insulation shall be installed and all seams, sealed, with Benjamin Foster sealant, according to manufacturers recommendations.
- B. On piping systems requiring insulation all pipe insulation shall be continuous through point of support. Provide sheet metal saddles between insulation and pipe hangers.
- C. Where handicapped lavatories and or sinks are indicated on the drawings, insulate all exposed piping below the fixture.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Refer to Part 3 execution: schedule for requirements regarding where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Insulation products shall contain no formaldehyde based binders or shall be third-party certified for conformance with Green Guard Children and Schools or Indoor Advantage Gold.
- D. Flexible Elastomeric:
 - Products:
 - Aeroflex USA Inc.; Aerocel.
 - Armaceil LLC; AP Armaflex.
 - Nomaco; Flex-Therm Pipe
- E. Mineral-Fiber Blanket Insulation:
 - Products:
 - CertainTeed Corp.; Duct Wrap.
 - Johns Manville; Microlite.
 - Knauf Insulation; Duct Wrap with Ecosse Technology.
 - Owens Corning; All-Service Duct Wrap Type 100.
 - Maximum K-Factor: 0.24 at 75 deg. F. and material thickness compressed 25%.
- F. Mineral-Fiber Board Insulation:
 - Products:
 - CertainTeed Corp.; Commercial Board.
 - Johns Manville; 800 Series Spin-Glas, Type 814.
 - Knauf Insulation; Insulation Board.
 - Owens Corning; Fiberglas 700 Series.
 - Mineral-Fiber, Preformed Pipe Insulation shall comply with ASTM C 547:
 - Products:
 - Johns Manville; Micro-Lok.
 - Knauf Insulation; 1000 (Pipe Insulation).
 - Owens Corning; Fiberglas Pipe Insulation, with factory applied all-service jacket (ASJ), Type: SSL II@
 - Maximum K-Factor: 0.23 at 75 deg. F mean temperature; 0.34 at 250 deg. F mean temperature.
- H. Mineral-Fiber, Pipe and Tank Insulation:
 - Products:
 - Certain Teed Corp.; GrimpWrap.
 - Johns Manville; MicroFlex.
 - Knauf Insulation; Pipe and Tank Insulation, with Ecosse® Technology.
 - Owens Corning; Fiberglas® Pipe and Tank Insulation for systems operating at temperatures to 650°.
 - Maximum K-Factor: 0.24 at 75 deg. F mean temperature; 0.39 at 300 deg. F mean temperature.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:
 - Comply with ASTM C 449 / C 449M

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. PVC Jacket Adhesive: Compatible with PVC jacket.
 - Products:
 - Dow Chemical Company (The); 739, Dow Silicone.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.5 SEALANTS

- A. Sealants shall be provided per manufacturer's installation requirements.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing.



**HOWARD COUNTY GOVERNMENT
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PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A FULLY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. EXPIRATION DATE 01/31/2020. STATE OF MARYLAND LICENSE NUMBER: 17855

KEY PLAN



PHASE:

**CONSTRUCTION
DOCUMENTS**

PROJECT:

**BELMONT
MAINTENANCE
SHOP**

6555 BELMONT WOODS RD
ELKRIDGE, MD 21075

REVISIONS

| NO. | DATE | ISS |
|-----|------|-----|
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4. Valving Specialties:
- Water Safety Relief Valves:
 - Provide as manufactured by Watts Regulator, Spence, or an acceptable comparable product.
 - 125 psig working pressure and 250°F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code.
 - Combined Pressure/Temperature Relief Valves:
 - Provide as manufactured by Watts Regulator, Spence, or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION:

- Verify excavations and trenches are ready to receive piping.
- Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of installed devices. Do not proceed with installation until unsatisfactory conditions have been corrected.
- Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- Examine substrates and conditions under which pipe expansion joints, pipe alignment guides, and pipe anchors are to be installed. Do not proceed until unsatisfactory conditions have been corrected.
- Do not enclose, cover, or put into operation any piping system until it has been inspected by the authority having jurisdiction and tested as specified herein.

3.2 PIPING SYSTEM INSTALLATION:

- Install all, horizontal and vertical, non waste and storm water piping systems level and parallel to the building walls, and partitions.
- Install all, horizontal waste, vent and storm water piping systems parallel to the building walls, and partitions with the required minimum slope required by code to provide gravity drainage to the vertical waste, vent and rainwater leaders.
- Install all, vertical waste, vent and storm water (rain water leader) piping systems parallel to the building walls, and partitions with the required minimum slope required by code to provide gravity drainage to the vertical waste, vent and rainwater leaders.

3.3 VALVE INSTALLATION:

- Valves shall be placed in such manner as to be easily accessible for smooth and easy hand wheel operation and packing maintenance.
- Install valves in piping where shown and where listed herein:
 - To balance flows in water piping systems.
 - To isolate all items of equipment.
 - To isolate motorized flow control valves.
 - To isolate branch lines and risers at mains.
 - To drain low points in piping systems.
 - To drain pipe risers.
 - To drain equipment.
 - To drain trapped sections in pipe systems.
- Where piping or equipment may be subsequently removed, provide valves with bodies having integral flanges or full lugs drilled and tapped to hold valve in place so that downstream piping or equipment can be disconnected and replaced with blank-off plate while valve is still in service.
- Shut off valves serving equipment and/or control valves shall be installed full size at the equipment connection.
- Where there is no interference, shut off valves shall be installed with hand wheel located up on the horizontal runs of pipe to prevent accumulation of foreign matter in working parts of valves.
- On valves, strainers, etc., installed in copper piping, provide a union on the discharge side of each valve, and threaded adapters where copper piping connects to valves, strainers, etc.
- Where valves are installed in piping systems for pressure gauges, P/T plugs, DP Switches etc., for each device provide a three quarter (3/4) inch tap in piping systems one (1) inch and larger and provide a one half (1/2) inch tap in piping systems less than one inch.
- Install drain valves at low points of risers and at trapped/low points in mains, branch lines, and everywhere else required to permit drainage of the entire piping system.

3.4 HANGER AND SUPPORT INSTALLATION:

Piping Systems: Hangers and supports shall be provided for all piping systems, as recommended by the hanger manufacturers for the existing structural elements.

END OF SECTION

SECTION 15184
REFRIGERANT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other Sections of Division 15.

1.2 SUMMARY

- Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of packaged air conditioning equipment.
- Design and installation shall be provided in accordance with equipment manufacturer's recommendations.

1.3 SUBMITTALS

- General: Submit each item in this Section according to the conditions of the Contract and Division 1 Specification Sections.
- Product data for the following products:
 - Each type valve specified.
 - Each type refrigerant piping specialty specified.
- Submit Shop Drawings showing design and layout of refrigerant piping, valves, expansion valves, drains accumulators, traps, hot gas bypass, filters, and miscellaneous specialties, etc. Shop Drawings shall also include but not necessarily be limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment. Provide a letter from the equipment manufacturer certifying the design is being provided in accordance with the equipment manufacturer's criteria.
- Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.
- Maintenance data for refrigerant valves and piping specialties, for inclusion in Operating and Maintenance Manual specified in Section 15050 - "Basic Mechanical Materials and Methods."

1.4 QUALITY ASSURANCE

- Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".
- Regulatory Requirements: Comply with provisions of the following codes:
 - ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping, latest edition.
 - ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration, latest edition.
 - International Mechanical and Plumbing Codes, latest edition.
 - PHCC: National Standard Plumbing Code, latest edition.

1.5 SEQUENCING AND SCHEDULING

- Coordinate the installation of roof piping supports, and roof penetrations with the Architect.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Refrigerant Valves and Specialties:
 - Alco Controls Div, Emerson Electric.
 - Danfoss Electronics, Inc.
 - EATON Corporation, Control Div.
 - Henry Valve Company.
 - Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division.
 - Sporlan Valve Company.

2.2 PIPE AND TUBING MATERIALS

- General: Refer to Part 3, Article "Pipe Application" for identification of systems where the below specified pipe and fitting materials are used.
- Drawn-Temper Copper Tubing: ASTM B 280, Type ACR or ASTM B88, Type I, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.
- Annealed-Temper Copper Tubing: ASTM B280, Type ACR or ASTM B88, Type K

2.3 FITTING MATERIALS

- Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

2.4 JOINING MATERIALS

- Brazing Filler for Joining Similar Metals: AWS A5.8, Classification BCuP series, with melting range from 1190 to 1480°F.
- Brazing Filler for Joining Dissimilar Metals: AWS A5.8, Classification BAg series, with melting range from 1125 to 1370°F.

2.5 VALVES

- General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.
- Globe: 450 psig maximum operating pressure, 275°F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.
- Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 °F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.
- Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300°F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.
- Solenoid Valves: 250°F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz, normally closed holding coil.
- Evaporator Pressure Regulating Valves: pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.
- Thermal Expansion Valves: thermostatically adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

2.6 REFRIGERANT PIPING SPECIALTIES

- General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.
- Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.
- Moisture/Liquid Indicators: 500 psig maximum operation pressure, 200°F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.
- Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:
 - Standard capacity desiccant sieves to provide micron filtration.
- Suction Line Filter-Drier: 350 psig maximum operation pressure, 225°F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.
- Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:
 - Flanged Unions: 400 psig maximum working pressure, 330°F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.
 - Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.
 - Suction Accumulators: Provide as manufactured by Refrigeration Research, Inc.

2.7 REFRIGERANT: Type shall be provided to suit equipment being served.

2.8 LOCKING ACCESS PORT CAPS

- Provide locking cap(s) with multi-key(s) for all refrigerant circuit access ports located outdoors.
- Locking caps shall be as manufactured by Win Air Company or comparable acceptable product.

PART 3 EXECUTION

3.1 EXAMINATION

- Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.2 PREPARATION

- Pre-Cleaning:
 - Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:
 - Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
 - Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- General: Hangers, supports, and anchors are specified in Section 15100 - "Building Services Piping."

3.4 INSTALLATION OF VALVING

- General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.
- Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere in accordance with manufacturer's instructions.
- Install a full sized, 3-way-valve bypass around each drier.
- Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
 - Electrical wiring for solenoid valves is specified in Division 16. Coordinate electrical requirements and connections.
- Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
 - Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 - Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 - Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 - Where external equalizer lines are required, make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.
- Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.5 PIPING APPLICATION

- Provide Type ACR drawn copper tubing with wrought copper fittings and brazed

joints above ground, within building. Provide Type K, annealed temper copper tubing for 2 inch and smaller without joints, within enclosed areas. Mechanical fittings (crimp or flair) are not permitted.

- Install annealed temper tubing in pipe duct. Vent pipe duct to the outside.

3.6 INSTALLATION OF PIPING

- Size piping and install refrigerant piping, traps, specialties as necessary for a complete and operational system in accordance with equipment manufacturer's recommendations.
- General: Install refrigerant piping in accordance with ASHRAE Standard 15 "The Safety Code for Mechanical Refrigeration". Unless specified otherwise by the Section, comply with Section 15100 - "Building Services Piping" - "Piping System Installation.
 - Install piping in as short and direct arrangement as possible to minimize pressure drop.
 - Install piping for minimum number of joints using as few elbows and other fitting as possible.
 - Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
 - Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
 - Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 - Do not install insulation until system testing has been completed and all leaks have been eliminated.
 - Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

- Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- Slope refrigerant piping as follows:
 - Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.
 - Install horizontal suction lines with 1/2" per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - Install traps and double risers and where required in accordance with equipment manufacturer's recommendations to entrain oil in vertical runs.
 - Liquid lines may be installed level.

K. Use fittings for all changes in direction and all branch connections.

- Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.

- Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.
- Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.
 - Install moisture/liquid indicators in lines larger than 2 1/8" OD, using a bypass line.

- Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.
- Install flexible connectors at the inlet and discharge connection of compressors.

- Refrigerant circuit access ports located outdoors shall be fitted with locking-type-tamper-resistance caps.

3.7 CONSTRUCTION

- Pipe Joints:
 - Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

- WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 - CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do no apply heat near the bulb of the expansion valve.
 - Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
 - Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.
- Equipment Connections:
 - The Drawings indicate the general arrangement of piping and fittings.
 - Install piping adjacent to machine to allow servicing and maintenance.

3.8 REFRIGERANT PIPING SYSTEMS

- Inspect, test and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI, "Refrigerant Piping and Heat Transfer Components", 2001, and as follows:
 - All refrigerant tubing shall be tested before tube insulation is applied.
 - Note: The use of compressed air for pressure testing refrigerant tubing will not be permitted.
 - Refrigerant relieve valves, if installed, shall be removed prior to pressure testing and shell openings plugged. After system is tested and found to be completely tight, relief valves shall be reinstalled prior to system evacuation.
 - Each tubing system shall be pressure tested with dry nitrogen. Leaks shall be repaired by removing and remaking the defective joint. No caulking will be permitted. After repair of leaks, system shall be retested and provided tight.
 - Tubing shall be tested as a minimum of 300 psig on the high side of 225 psig on the low side. Suggested procedure is as follows:
 - Charge system with oil pumped dry nitrogen to a pressure of 100 psig. Make a soap bubble test of all joints and all connections. Mark all leaks, blow down and repair all leaks.
 - After above test and repair, charge high side with R-507 or R-12, R-22 or R-502 gas (based upon application) to a pressure of 30 psig. Make a rapid leak check at this pressure using an electronic leak detector. If no leaks are found, raise pressure to 300 psig on the high side of 225 psig on the low side using oil pumped dry nitrogen.
 - Leave nitrogen and refrigerant mixture overnight to permit mixing by diffusion. Check diffusion and leak tester operation by venting a flange or valve stem. Make a thorough leak test. If leaks are found, blow down, repair and retest. Continue this procedure until entire system is provided to be absolutely tight.
 - After the refrigerant piping has been pressure tested and proven tight, and before piping insulation is applied, the entire system shall be evacuated with a vacuum pump to remove air and moisture. Evacuation shall be performed with all spaces containing refrigerant piping or equipment at no lower than 50°F.
 - Manual valves except those open to atmosphere shall be opened and all controls such as solenoids shall be jacked open. Any gauges or pressure controls which could be damaged by a deep vacuum shall be valved off. Seal caps on valves shall be in place and tight. Any valves open to atmosphere shall be closed and capped.
 - The entire system shall be double evacuated to 1500 microns Hg absolute (1.5 torr) as follows:
 - When vacuum pump is started, vacuum should pull down fairly rapidly to 25,000 microns Hg absolute (28.94"). If vacuum does not pull below 25,000 microns, there are leaks in the system and leak test procedure must be repeated.
 - At approximately 10,000 microns, evaporation of free water in the system will be rapidly accelerated and vacuum will tend to remain constant as evaporation rate begins to equal vacuum pump capacity. Depending on amount of water, ambient temperature and vacuum pump capacity, it may take several hours to make any noticeable decrease in vacuum below 10,000 microns. During this period, apply heat to any low points or suspected points of moisture. Feel pipes for cold spots and supply heat.
 - Continue evacuation until a pressure of 1,500 microns (1.5 torr) minimum is reached, then break the vacuum and pressurize to 10 psig with oil pumped dry nitrogen as a holding charge until ready for charging.
 - When ready for charging, vent nitrogen holding charge to atmosphere and re-evacuate down to a minimum of 1,500 microns. Break vacuum with refrigerant gas. Do not use liquid.
 - Repair leaking joints using new materials, and retest for leaks.

3.9 ADJUSTING AND CLEANING

- Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- Clean and inspect refrigerant piping systems in accordance with industry standards.
- Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

END OF SECTION

SECTION 15400
PLUMBING FIXTURES, DRAINAGE SPECIALTIES AND EQUIPMENT

PART 1 GENERAL

1.1 GENERAL:

- Provide all plumbing fixtures and specialties indicated on the drawings and as specified hereinafter, complete with all trim, hangers, fittings etc. for a complete installation. All exposed metal parts shall be polished chrome plated brass unless otherwise specified below.
- Provide an outlet floor drain trap primer for each floor drain where indicated on the drawings and as specified below.
- Coordinate all required plumbing rough-in locations with casework manufacturer and all other trades.



HOWARD COUNTY GOVERNMENT
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PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND. EXPIRATION DATE 01/11/2020. STATE OF MARYLAND LICENSE NUMBER: 17655

KEY PLAN



PHASE:

CONSTRUCTION
DOCUMENTS

PROJECT:

BELMONT
MAINTENANCE
SHOP

6555 BELMONT WOODS RD
ELKBRIDGE, MD 21075

REVISIONS

| NO. | DATE | ISSUED FOR |
|-----|---------|------------|
| | 1/19/18 | 75% CD |
| | 2/20/18 | 100% CD |

PROJECT NO.

DATE

SCALE AS NOTED

DRAWING TITLE

MECHANICAL
SPECIFICATIONS

SHEET NUMBER

M403

D. Trace the routing of the existing sub-slab sanitary piping serving the tenant space. The tracing of the sanitary shall be done to verify routing, locations, and depth of the sub-slab piping. If the routing differs substantially from the proposed design, notify the owner/architect of all required modifications and associated cost before commencing with work.

1.2 DEFINITIONS

- A. Lead Free:
 - The pipes, pipe fittings, plumbing fittings or fixtures in plumbing systems that are intended to dispense potable water for human consumption, including drinking and cooking, shall be "lead free", containing not more than a weighted average of 0.25% lead with respect to the wetted surfaces.
 - Solder and flux for soldered joints in potable water piping shall be "lead free", containing not more than 0.2% lead free.

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES:

- A. Provide plumbing fixtures of make and model as indicated on the contract drawings.
- B. Furnish and install all fixtures and trim necessary to complete fixture installation. Provide approved stop valve, to match fittings, on both hot and cold water supplies to each fixture, all fixtures requiring hot and cold water shall have cold water faucets on right and hot water faucets on left. Exposed metal work shall be chrome plated red brass. Fixtures shall be white, unless otherwise specified. (Note: The "P" identification symbol with each fixture identified type shown on drawings.) Where fixtures tailpieces, traps and stop valves are not indicated, same shall be provided to suit fixture.
- C. Unless otherwise specified, the specified fixtures are taken from the catalogue of Zum for convenience only. Provide similar fixtures of Eljer Company, Elkay, American Standard, Kohler, Crane or an acceptable comparable product.
- D. Coordinate flush valve mounting heights for all water closets with the locations of grab bars; refer to Architectural Contract Drawings for exact grab bar locations.
- E. Mount lavatory 34" above finish floor.
- F. All exposed bolts, screws, fasteners, etc. shall be vandal proof.
- G. Utilize Sani-Sett setting compound for fixtures.
- H. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.
- I. Provide supports necessary to adequately and substantially hang and set fixtures. Supports shall be Zum, Josam or J.R. Smith and shall be suitable for wall types and thicknesses and piping arrangements shown.
 - Support for wall mounted, lavatories, etc.:
 - Where fixtures are supported from concrete or cinder block walls, install No. 10 USSG steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to view, place bolts in core of blocks and fill core with cement.
 - Where lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1 1/2" wide anchored to studs. Bolt heads shall be welded to channel web.
 - Concealed arm type lavatory supports, Zum ZR-1231 with cast iron headers, box steel stanchions, block type cast iron fee and header and chrome plated cast brass threaded escutcheons for slab type lavatories.
 - Provide rubber concussion washers between vitreous china fixtures and supporting brackets.
- J. Plumbing fixtures shall be caulked at walls and floors with silicone caulking material of same color as fixture(s).
- K. Locate countertop sinks and/or under counter sinks furnished under this Division. Furnish templates to the countertop fabricator for cutting of required holes.
- L. For sinks and fixtures specified under other divisions or other contracts and not provided with faucets, tailpieces, traps, stop valves and supply tubes, provide necessary fittings and completely connect the sins and fixtures.
- M. Hot and cold water connections to fixtures shall be provided with a stop valve, stop valves, risers, etc. Stop valves and risers shall be light commercial grade: as manufactured by Brasscraft, Central Brass or an acceptable comparable product. Commercial/Institutional grade: as manufactured by Chicago Faucet, Brass Craft, McGuire or an acceptable comparable product.
- N. All lavatories and sinks shall be provided with no lead faucets.

2.2 Water Heater (WH-1)

- A. Thermostat shall be surface-mount with high limit energy cut-off (manual reset) for safety.
- B. Tank shall have a brass drain valve and have low restriction.
- C. Tank shall have a liner to protect it from corrosion.
- D. Tank shall have a non-CFC foam insulation that covers the sides and top of tank to reduce heat loss.
- E. Water connections shall have true dielectric fittings.
- F. Tank shall have factory-installed heat traps to reduce heat loss in piping and minimize noise generation.
- G. Tank shall have a protective magnesium anode rod to minimize corrosion.
- H. Heating elements shall be able to available to operate in simultaneous or non-simultaneous operation.
- I. Tank shall have factory-installed T&P relief valve.
- J. Design shall have been evaluated by ETL in accordance with Part 280.707(d) of HUD Mobile Home Construction and Safety Standards for Energy Efficiency.

2.3 DRAINAGE SYSTEMS SPECIALTIES

- Cleanouts: ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug flashing flange and clamping ring, and a brass closure plug. Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring. Comparable products as manufactured by Josam, Watts or J.R. Smith may be submitted for review.
 - Cleanouts in Concrete Floors - Zum Model No. Z-1400-BP or Watts Model CO-200-RX, CO style to suit floor finish with round scoriated top.
 - Cleanouts in Finished Floors - Zum Model No. ZN-1400-BZ-BP style to suit floor finish with recessed top for tile or carpet.
 - material conforming to ASTM 3222. "AWCO" shall be cast in cover.
 - Cleanouts in Piping - Zum Model No. Z-1440-BP with bronze plug.
 - Cleanouts in Walls - Zune Model No. Z-1440-1-BP-VP style to suite all finishes with vandalproof screws.
- Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify walls and floor finishes are prepared and ready for installation of fixtures. Verify electric power is available and of correct characteristics. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install Work in accordance with all applicable codes, standards, and local authorities having jurisdiction requirements. Install each fixture with trap, easily removable for servicing and cleaning. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons. Install components level and plumb. Install and secure fixtures in place with wall supports or wall carriers and bolts as recommended by fixture manufacturer. Seal fixtures to wall and floor surfaces with Sani Sett setting compound. Color to match fixture. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

3.8 SCHEDULES

- A. Refer to contract drawings for plumbing fixture schedule. Fixture rough-in, refer to plumbing fixture schedule shown on contract drawings.

END OF SECTION

SECTION 15700

HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 GENERAL

- 1.1 GENERAL: Provide HVAC equipment of make and model as indicated on the contract drawings, and as specified below, including all labor materials and equipment necessary for a complete installation.

1.2 COORDINATION:

- A. Coordinate installation of HVAC System Equipment with building structure
- B. Coordinate with Engineer regarding control sequence. Any deviation of the programmed controls from the specified controls should be clarified in writing and provided to the Engineer for review.
- C. Contractor is responsible for providing all control devices shown on the ATC diagram or points list in the contract documents unless otherwise specified. Prior approval by the Engineer is required, in writing, to change this requirement. If there are issues regarding these devices they should be documented in writing and provided to the Engineer for review.

PART 2 PRODUCTS

2.1 Split System Air Handling Unit (AHU-1 and CU-1):

- A. Provide split system heat pump unit with oil burner heat as manufactured by Allied Air. Units as manufactured by Carrier and Trane shall be submitted for comparable product.
- B. Outdoor Unit
 - System Description
 - Outdoor mounted air cooled condensing unit suitable for ground installation.
 - Unit shall be installed as part of a split system when matched with a factory approved air handling unit.
 - Unit shall be a draw thru design, with vertical condensers air discharge.
 - Standard Features
 - Equipment shall be factory assembled single piece outdoor condensing unit. Standard unit shall consist of a single compressor, condenser coil, outdoor fan, outdoor fan motor, piping, wiring, and controls in an outdoor weatherproof cabinet. Unit shall have a holding charge of refrigerant.
 - Unit cabinet shall be constructed of galvanized steel, with exterior surfaces coated with a baked polyester paint finish, and shall withstand a 750 hour salt spray test.
 - Compressor section shall have a compressor piped in a single refrigeration circuit. Compressor shall be sealed hermetic scroll type, mounted on external rubber isolators to minimize vibration transition and have internal over temperature and over current protection.
 - Condenser section shall consist of single coil and fan. Condenser coil shall have aluminum plate fins with 3/8 inch OD copper tubes, and have an integral subcooling circuit. Condenser coil shall be protected by a louvered panel type coil guard. Fan motor shall be of the direct drive totally enclosed type, with permanently lubricated bearings, and have internal overload protection.
 - Refrigeration circuit shall have sealed type solid core filter dryer, to eliminate contaminants and moisture, for field installation in the liquid line. Unit shall be equipped with secured, reusable service valves, for both liquid and suction line connections. Unit shall have an operating charge of R410, suitable for up to 15 feet of line length.
 - Unit control circuit shall be 24 volt, provided by a field supplied transformer. Compressor safeties shall consist of an internal automatic reset high pressure relief valve, and an external high pressure switch to protect against extreme condenser air temperature or restricted condenser airflow. Compressor and fan motor contractors shall be factory installed.
- Operating Characteristics
 - Standard unit shall be capable of operating mechanical cooling in ambient temperatures from 50F to 115F.
 - Unit efficiency shall comply with ASHRAE 90.2 standards when rated at AHR conditions.
 - Unit shall be designed for low noise generation, with ARI certified sound

2.2 Exhaust Fan (EF-1):

- A. Direct Drive Premium Ceiling Mounted Centrifugal Exhaust Fans:
 - Manufacturer:
 - Fans shall meet model numbers, types, sizes, capacities, and electrical characteristics as indicated on the contract drawings. Acceptable manufacturers: Acme, Cook, Greenheck, Penn Ventilator or Twin City Blower Company.
 - General:
 - Maximum operating temperatures shall be 130 Fahrenheit (54.4 Celsius).
 - Sound levels shall be as low as 0.7 AMCA sones.
 - Shall be UL/cUL listed for above bathtub exhaust.
 - Fans shall be UL/cUL listed 507 - Electric Fans.
 - Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number.
 - Wheel:
 - Shall be forward curved centrifugal wheel.
 - Shall be constructed of galvanized steel or calcium carbonate filled

- power level not to exceed 80dBA.
- Cooling performance shall be balanced capacity of the condensing unit matched with a factory approved fan coil unit, at design conditions, not point capacity of the condensing unit only.
- Submittals shall be combination ratings showing performance of the split system at specified conditions. Copies of unit performance data at nominal conditions will not be acceptable.
- Refrigerant piping to be field installed per equipment manufacturers recommendations.
- Factory Installed Accessories
 - Access-of-charge switch, liquid line installed, to protect against a loss of refrigerant charge.
- Field Installed Accessories
 - Rapid cycle protector to protect compressor from rapid cycling on a safety switch.
 - Start capacitor and relay kit to provide hard start capability for single phase motors.
 - Modulating sold state head pressure control to allow mechanical cooling down to 0 F ambient.
 - Crankcase heater to improve lubrication and minimize flooding during startup.
 - Liquid line sight glass to facilitate refrigerant operating charge diagnosis.
 - Leg support kit to elevate the unit 2 inch above grade to avoid standing water and debris.

C. Indoor Unit

- System Description
 - Indoor mounted gas-fired furnace. Unit shall be manufactured for vertical upflow installation, and be suitable for ducted systems.
 - Unit shall be designed to mate with an accessory evaporator coil, as part of a split system, when combined with a factory approved condensing unit.
- Standard Features
 - Equipment shall be indoor mounted blow-thru packaged oil furnace suitable for ducted systems. Unit shall consist of a forward curved centrifugal fan, direct drive motor, primary oil heat exchangers, oil burner, oil pump, programmable electronic control board.
 - Unit casing shall be galvanized steel, coated with a baked on powder enamel finish. Unit shall compact, with a maximum height of 54 inch without cooling coil. Casing panels shall be insulated with 1 inch thick fiberglass having an aluminum foil backing adjacent to the conditioned air stream. Unit shall have a supply duct collar and be capable of return duct connection thru the bottom or thru one side.
 - Supply air section shall consist of supply fan and motor. Fan wheel shall be forward curved centrifugal, direct drive type, statically and dynamically balanced. Fan motor shall be PSC multi-speed type. Fan wheel shall be designed for quiet operation.
 - Oil heat section shall consist of an aluminized steel heat exchanger with ceramic fiber combustion chamber and have large diameter stainless steel clean out ports. Burner shall be a Beckett flame retention AFG type and have a solid state spark ignition system.
 - Return air section shall have return duct opening on the bottom, and be capable of field modification for return duct connection on one side.
 - Control section shall have a 40VA 24 volt control circuit transformer and supply fan motor contractor. Unit safety controls consist of a fan limit switch, primary safety control, flame detector, and pre/post purge timers.
- Operating Characteristics
 - Minimum entering air temperature on the primary heat exchanger shall be 60F. Minimum equipment room temperature shall be 32F.
 - Unit efficiency shall be GAMA certified at no less than 94% AFUE.
 - Unit shall be capable of providing the capacities specified on the equipment schedule. Cooling performance with accessory evaporator coil, shall be the balanced capacity of the cooling coil when combined with factory approved condensing unit, not point capacity of the evaporator coil alone. Submittals shall be combination ratings showing performance of the split system at specified conditions; copies of point capacities will not be acceptable.
- Factory Installed Accessories
 - Thermostatic expansion valve to provide refrigerant flow control to 25% of nominal valve rating.
- Field Installed Accessories
 - Unsplit R410 evaporator coil to provide single stage cooling and designed to mate to the furnace outlet.
 - Evaporator coil mounting kit to allow the evaporator coil inlet to mate to the furnace outlet.
 - Evaporator freeze protection to provide primary passive freeze protection for the cooling coil.
 - Combustion air kit to allow combustion air to be brought to the furnace from outside the building.
 - Clean out cap kit to facilitate removal of soot and dust from oil heat combustion system.
 - External side return 16x25x1 inch disposable media air filter rated at MERV-3.
 - Return air duct filter track to hold the MERV-3 rated disposable air filter (field applied).
 - Draft control damper to ensure combustion air thru the flu is properly vented to the atmosphere (field supplied).
 - Electronic space thermostat, with digital display, to provide temperature control and occupied times to unit mounted BMS I/O module. hermostats shall have a control range for heating of 40°F to 90°F and cooling of 50°F to 99°F. Thermostat shall be 7-day programmable thermostat with flex scheduling with permit schedule override. The display shall be backlit with the following modes: Auto, Heat, cool, fan on, and off.

- Supply Fan (SF-1):
 - Belt Driven Backward Inclined Inline Fans:
 - Manufacturer:
 - Fans shall meet model numbers, types, sizes, capacities, and electrical characteristics as indicated on the contract drawings. Acceptable manufacturers: Acme, Cook, Greenheck, Penn Ventilator or Twin City Blower Company.
 - General:
 - Base fan performance at standard conditions (density 0.075 Lb. /ft3).
 - Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
 - Each fan shall be belt driven in AMCA arrangement 9 only with wheel secured to the fan shaft.
 - Fans are to be equipped with lifting lugs.
 - After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphating process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
 - Fan Housing and Outlet
 - Fan housing to be aerodynamically designed with punched inlet and outlet flanges for ductwork connection on inline fans.
 - Fan housing shall be constructed of rolled steel with a continuous seam weld.
 - Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.
 - Either an OSHA compliant weatherhood, or an OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).
 - Wheel:
 - The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.
 - Level I: Wheel shall be constructed with half-welded and half-riveted aluminum. The maximum pressure capabilities shall be 2 inches W.G.
 - Aluminum parts shall not require protective coating.
 - The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.
 - Motors:
 - Motors shall meet or exceed EPACK (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Explosion Proof (EXP) with a 1.15 service factor.
 - Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
 - Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
 - Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.
 - Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
 - Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class (Average Life or (L-50) of 400,000 hours).
 - Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be approved.

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- A. Provide split system heat pump unit with oil burner heat as manufactured by Allied Air. Units as manufactured by Carrier and Trane shall be submitted for comparable product.
- B. Outdoor Unit
 - System Description
 - Outdoor mounted air cooled condensing unit suitable for ground installation.
 - Unit shall be installed as part of a split system when matched with a factory approved air handling unit.
 - Unit shall be a draw thru design, with vertical condensers air discharge.
 - Standard Features
 - Equipment shall be factory assembled single piece outdoor condensing unit. Standard unit shall consist of a single compressor, condenser coil, outdoor fan, outdoor fan motor, piping, wiring, and controls in an outdoor weatherproof cabinet. Unit shall have a holding charge of refrigerant.
 - Unit cabinet shall be constructed of galvanized steel, with exterior surfaces coated with a baked polyester paint finish, and shall withstand a 750 hour salt spray test.
 - Compressor section shall have a compressor piped in a single refrigeration circuit. Compressor shall be sealed hermetic scroll type, mounted on external rubber isolators to minimize vibration transition and have internal over temperature and over current protection.
 - Condenser section shall consist of single coil and fan. Condenser coil shall have aluminum plate fins with 3/8 inch OD copper tubes, and have an integral subcooling circuit. Condenser coil shall be protected by a louvered panel type coil guard. Fan motor shall be of the direct drive totally enclosed type, with permanently lubricated bearings, and have internal overload protection.
 - Refrigeration circuit shall have sealed type solid core filter dryer, to eliminate contaminants and moisture, for field installation in the liquid line. Unit shall be equipped with secured, reusable service valves, for both liquid and suction line connections. Unit shall have an operating charge of R410, suitable for up to 15 feet of line length.
 - Unit control circuit shall be 24 volt, provided by a field supplied transformer. Compressor safeties shall consist of an internal automatic reset high pressure relief valve, and an external high pressure switch to protect against extreme condenser air temperature or restricted condenser airflow. Compressor and fan motor contractors shall be factory installed.
- Operating Characteristics
 - Standard unit shall be capable of operating mechanical cooling in ambient temperatures from 50F to 115F.
 - Unit efficiency shall comply with ASHRAE 90.2 standards when rated at AHR conditions.
 - Unit shall be designed for low noise generation, with ARI certified sound

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END OF SECTION

- polypropylene.
- Motor:
 - Motor enclosures shall be open dripproof (ODP), opening in the frame body and or end brackets.
 - Motor shall be permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase.
 - Motor shall be mounted on vibration isolators and be accessible for maintenance.
 - Shall come with thermal overload protection.
- Housing:
 - Shall be constructed of heavy gauge galvanized steel.
 - Interior shall be lined with 0.5 inches of acoustical insulation.
 - Profile shall be as low as 10 1/2 inches.
- Provide Spring Loaded Aluminum Backdraft Damper:
- Outlet:
 - Shall be field rotatable from horizontal to vertical discharge.
 - Duct collar shall include an aluminum backdraft damper.
- Grille:
 - Types: Aluminum
 - Shall be constructed of high impact polystyrene for sizes 50 thru 390, plastic shall be factory standard on unit under 390.
 - Shall be constructed of aluminum non-yellowing for sizes 410 thru 1550, aluminum shall be factory standard on units over 410.
- Provide External Electrical Access:
 - Shall eliminate removing the motor pack on installation.
- Mounting Brackets:
 - Shall be adjustable for multiple installation conditions.
- Options/Accessories:
 - Ceiling Radiation Damper:
 - UL classified and shall be rated for three to four hours fire resistance.
 - Shall be mounted directly beneath the fan.
 - Shall adhere National Fire Protection Association (NFPA), Standard 90A, which requires the opening in fire rated ceiling/floors to be protected by rated CRD's.
 - Disconnect Switches:
 - Disconnect provided under Division 16.
 - Wall Discharge:
 - Type: Round Connection, hooded wall cap model WC
 - Vibration Kit:
 - Provide for suspended installations.
 - Provide prepunched hole for ease of installation and provide all hardware to mount one unit.

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END OF SECTION

- Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.
- Housing Supports and Drive Frame:
 - Housing supports shall be constructed of structural steel with formed flanges.
 - Drive frame shall be welded steel which supports the motor.
- Disconnect Switches:
 - Disconnect provided under Division 16.
- Duct Collars:
 - Shall be of square design to provide a large discharge area.
- Access Panel:
 - Provide two sided access panels, to allow access to all internal components.
 - Locate perpendicular to the motor mounting panel.
- Provide the following:
 - Dampers:
 - Types: motorized
 - Provide galvanized frames with prepunched mounting holes.
 - Shall be balanced for minimal resistance to flow.
 - Provide end switch for motorized damper assembly.
 - Finishes:
 - Types: Baked Enamel
 - Inlet and Outlet Guards:
 - Shall be constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
 - Insulated Housing:
 - Shall be thickness: 1"
 - Provide for noise reduction and condensation control.
 - Constructed of fiberglass liner.
 - Isolation:
 - Refer to Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment".
 - Motor Cover:
 - Shall be constructed of galvanized steel.
 - Shall cover motor and drives for safety.
 - Shall be standard on units specified with UL.

- 2.4 Unit Heater (UH-1,2):
 - Heat Exchanger and Elements:
 - Heavy welded, painted carbon steel with aluminum fins liquid heat exchanger, liquid filled with three-immersion type copper sheathed elements. The elements shall have the highest quality nickel-chromium resistance wire encased in a magnesium oxide dielectric and be hermetically sealed into the heat exchanger core. The heat transfer fluid is Ethylene-glycol solution for operation to -49 degrees F (- 45 degrees C). Stainless steel and aluminum pressure relief valve for overpressure.
 - Thermal Cutout High Limit Protection and Optional Pilot Light:
 - The capillary type manual reset thermal cutout shall be rated for 6000 cycles of service and mounted in the liquid filled heat exchanger. An optional pilot light to indicate manual reset tripped, if safe operating temperatures are exceeded, is located on control enclosure.
 - Motor:
 - The motor shall be a permanent split capacitor type, permanently lubricated, ball bearing type. The motor shall be rated for hazardous location and operate at rated voltage of heater, 60 Hz, 1725 RPM.
 - Control Enclosure:
 - All controls shall be factory installed and wired in a hazardous location enclosure. Contactors and back-up contactors are heavy duty type and break all ungrounded conductors and be rated for 100,000 cycles at full load. Standard 24-Volt control circuit shall be supplied by internal class II transformer. An optional factory wired integral thermostat or standard terminal block for field wiring to optional remote wall thermostat are wired in control panel. No fan delay relay.
 - Disconnect Switch:
 - Factory mounted and wired hazardous location disconnect switch is available as optional accessory.
 - Cabinet With Adjustable Louvers:
 - The Cabinet shall be 14 gauge, cold rolled steel with powder coated epoxy finish. Plated fan guards with less than 1/4 inch spacing to cover motor and fan shall conform to OSHA Requirements.

- 2.5 Unit Heater (UH-3,4):
 - The cabinet shall be made of 18 gauge die formed furniture grade steel. Individual adjustable louvers with 30 degrees downward stops shall be furnished to provide desired control of discharge air. All metal surfaces of the enclosure shall be phosphate coated to resist corrosion and finished in a durable polyester powder coat finish.
 - Mounting brackets designed for either ceiling or wall swivel mounting shall be furnished as shown on the heating schedule.
 - Heaters shall be of the draw-through air flow design to eliminate the element hot spots and extend design life.
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