

SECTION 200000

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for work under Division 20.
- B. Coordinate the work of this Section with the requirements of the Project.

1.2 DEFINITIONS

- A. Following are definitions of terms and expressions used in the Mechanical Sections in addition to definitions found in the Contract Conditions:
 - 1. "Piping" includes pipe, fittings, valves, hangers, and other accessories that comprise a system.
 - 2. "Ductwork" includes ducts, fittings, housings, dampers, hangers, and other accessories, which comprise a system.
 - 3. "Refurbish" shall include but not be limited to: inspecting/repairing unit cabinet, such as repairing, seals/latches, curbs, etc., cleaning coils, replacing belts, lubricating bearings, changing filters, inspecting and cleaning gas fired heat exchanger, cleaning/repairing condensate drain and secondary drain pan, check and adjust refrigeration charge on each unit, leak test and repair any refrigeration leaks, etc. to bring the piece of equipment being refurbished into the manufacturers original operating specifications/tolerances and provide warranty of operability for 60 days after the systems have been turned over to the Owner.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Work shall conform to the requirements of the codes, laws and ordinances of Millersville University, National Fire Protection Association, American Society of Mechanical Engineers and other authorities having jurisdiction.
 - 2. Comply with applicable codes, laws, standard practices.
 - 3. Comply with the standards of good practice as outlined in the ASHRAE Guide, the Sheet Metal and Air Conditioning Contractor's Association's "Duct Manual", and the Apprentice Training Manual of the Steam Fitters Union.
 - 4. The requirements of the authorities having jurisdiction shall take precedence over the Drawings and Specifications and changes required by the authorities shall be made after review by the Architect.

1.4 SUBMITTALS

- A. Shop drawings are required for the following:

1. Heating and Air Conditioning
 - a. Air Devices
 - b. Insulation
 - c. Exhaust Fans
 - d. Heating and Air Conditioning Equipment
 - e. Clerestory Sheet Metal
 - f. Temperature Controls
 - g. Testing, Adjustment and Balancing Reports and Qualifications
 2. Field Instructor's Name and Credentials.
- B. Review of shop drawings does not relieve the Contractor of responsibility for complying with the contract documents.

1.5 PROTECTION

- A. Protect material and equipment from damage.
- B. Post notices prohibiting the use of water closets.
- C. Provide plastic protection inserts, specifically manufactured for the bathtubs and shower stalls.
- D. Cap or plug openings in equipment, piping and ductwork with proper caps and plugs.
- E. Building materials should be stored in a weather-tight, clean area prior to unpacking for installation.
- F. Accumulation of water during construction should be avoided and any porous construction materials such as insulation should be protected from moisture.

1.6 VARIANCES

- A. Where conflicts exist within the contract documents, request clarification prior to the submission of a bid. If clarification is not requested, provide the work representing the higher cost and quality.

1.7 WARRANTY

- A. During the warranty period, make the proper adjustments of systems, equipment and devices installed and perform work necessary to ensure the efficient and proper operation of the systems, equipment and devices.
- B. Certain items of equipment shall be warranted for a longer time than the general warranty period. Provide for service or replacement required in connection with the warranty of these items.
- C. The warranty period shall not begin until the project has reached substantial completion. Any warranty limits from the manufacturer related to delivery of equipment or unit startup shall be between the contractor and the manufacturer only and shall not impact the warranty between the owner and the contractor.

PART 2 - PRODUCTS

2.1 PRODUCTS TO BE USED

- A. Items are specified by designations such as trade name, manufacturer's name, catalog number and indicate the capacity and quality of the products or materials to be used on this project.
- B. Only products indicated on Contract Documents by name and model number have been coordinated with other trades. Coordinate items of other manufacturer with other trades.
- C. Product indicated on the Contract Documents by name and model number are the basis of design. Additional manufacturers named in the specifications are approved equals. Any substitution beyond the named equal manufacturers is required to follow the substitution process outlined in Division 1 of the specifications.

2.2 MATERIALS AND WORKMANSHIP

- A. Items shown and not specifically called for, or items specified and not specifically indicated or detailed on the Drawings, or items neither specified nor shown, but which are reasonably incidental to and commonly required to make a complete job, shall be provided.

2.3 FOUNDATIONS AND EQUIPMENT SUPPORTS

- A. Provide foundations, supports, curbs and bases for equipment, as indicated or necessary for satisfactory installation and operation of equipment. Furnish and set anchor bolts.
- B. Concrete pads shall be 4 inches thick minimum, thicker if necessary to accommodate a particular piece of equipment. Edges shall be beveled with outer edge extending 3 inches beyond equipment. Provide concrete pads for floor-mounted equipment. Exterior pads shall be reinforced and shall have edges turned down to below the frost line. Exterior pads shall extend eight inches beyond edges of equipment and shall be sloped for drainage.
- C. Exterior equipment pads shall be 3 inches thick minimum E-Lite plastic pads manufactured by Diversitech with 3" high riser legs and shall extend 6 inches beyond edges of equipment and shall be sloped for drainage.
- D. Floor mounted stands, supports, rods or legs, where required, shall be constructed of structural steel shapes (angles, channels) of Kindorf or Unistrut or steel pipe and fittings securely braced and fastened to flanges bolted to the floor. Minimum rod size shall be 3/8-inch diameter. Paint steel with rust inhibiting paint.

2.4 ROOF SUPPORTS AND CURBS

- A. Provide equipment supports and curbs for the equipment and piping installed on or through the roof. Roof curbs shall be approved for use by the National Roofing

Contractors National Association and shall be a minimum of 14 inches high. Curbs shall be sloping roof type suitable for pitch of the roof and shall set the equipment level. Curbs shall be double wall insulated type.

- B. Provide wood blocking or adjust the height of the custom curb to raise the level of the bottom of the curb to be level with the top of the finished roof assembly.
- C. Pipe curb assemblies, except for plumbing vent pipes shall be constructed of 18 gauge galvanized steel with base plate, raised cant, wood nailer strip and galvanized steel counter flashing. Top shall be provided with acrylic clad ABS plastic cover and graduated neoprene boots secured to cover and pipes by stainless steel band clamps. Pipe curbs shall be Pate Company PCA-5 or equivalent of Thy Curb.
- D. Equipment supports shall be constructed of 18 gauge galvanized steel with base plate, raised cant, insulation, wood nailer strip and galvanized steel counter flashing. Equipment supports shall be Pate Company ES-5b or equivalent of Thy Curb.
- E. Roof mounted stands, supports, rods or legs, where required, shall be constructed of structural steel shapes (angles, channels) of Kindorf or Unistrut or steel pipe and fittings securely braced and fastened to flanges bolted to the associated equipment support. Minimum rod size shall be 3/8-inch diameter. Paint members which have been cut or have been damaged with touch up rust inhibiting paint.

2.5 HANGERS AND PIPE SUPPORTS

- A. Provide pipe hangers and supports to maintain required slope and alignment for equipment and piping. Pipe hangers shall be as manufactured by Carpenter & Patterson, Fee & Mason, Modern Hanger or Grinnell.
- B. Pipes may not be supported from other pipes. Trapeze hangers may be used for parallel runs of pipe with same slope.
- C. Provide sway bracing at sufficient intervals to prevent lateral motion of horizontal or vertical piping and ductwork as required by the jurisdiction to meet the appropriate regional requirements.
- D. For pipe and tubing, both horizontal and vertical, and regardless of the spacing of other supports, provide supports at or near changes in direction. Hangers shall be spaced at not over 6 feet apart for 1/2 inch pipe, not over 8 feet apart for 3/4 and 1-inch pipe and not over 10 feet for larger sizes.
- E. For steel bar joist construction, hanger rods shall be supported from the top chord of the joists or from panel points of the lower chord of the joists. Where piping runs parallel to joists or where hangers are required at other than joist locations, provide steel angles welded to joists to support hangers so that weight is supported from the top chord of the joists.
- F. Hangers for pipe shall be similar to Carpenter & Paterson "Clevis" figure 100. Hangers for insulated lines with vapor barrier and carrying fluids with temperatures

below 70 degrees shall be large enough to permit continuous insulation. Hangers on vapor barrier insulated piping shall be provided with rigid protector saddles with rigid core of insulation to thickness of adjacent insulation. Saddles shall be 16 gauge galvanized steel and shall cover one half of the circumference of the pipe covering. Saddle shall be secured to insulation with adhesive.

- G. Pipes upon or within close distance of walls shall be carried by wall brackets, Carpenter & Paterson, Fig. 221, 139, or 227 as approved.
- H. Support vertical lines at floor level with extension pipe clamps. Support lowest level of riser with pipe hanger as specified above on horizontal pipe as close to riser as possible.
- I. Special supports required shall be provided to suit the conditions.
- J. Expansion bolts or wood plugs will not be permitted in slag block walls. Equipment hung on such walls shall be supported by through bolts or approved anchor bolts set into masonry as the wall is laid up.

2.6 OPENINGS, CHASES, LINTELS AND SLEEVES

- A. Determine the location and size of chases, lintels and openings necessary for the proper installation of the work and provide them during the erection of the work in which such chases and openings occur.
- B. Provide sleeves through walls and floors for pipes. Sleeves through walls shall be of sufficient size to permit the insulation, where specified, to continue through the sleeve. Sleeves through walls shall be flush with the walls.
- C. In case cutting of building construction is necessary, including cutting of structural members, such cutting shall be done and repaired to match original condition of the work.
- D. Where non-combustible pipes pass through sleeves or around ductwork through openings in fire rated wall, floor-ceiling and ceiling-roof assemblies, seal openings with a Underwriters Laboratories classified firestop method. Firestop method shall be a one part, intumescent (expands with heat), latex elastomer capable of expanding a minimum of three times. Firestop materials shall be UL listed when tested in accordance with ASTM E814 for a two hour fire (F) and temperature (T) rating.
- E. If combustible piping materials are used, a UL listed firestop method shall be provided where the combustible materials penetrate fire rated wall, floor-ceiling and ceiling-roof assemblies. Firestop method shall be classified by UL as a through-penetration firestop device when tested in accordance with ASTM E814 for a two hour fire (F) and temperature (T) rating. Plastic piping materials, including, but not limited to PVC, CPVC and ABS, are combustible. Firestop method shall be similar to Nelson Firestop Products.

- F. Escutcheon plates shall be used to conceal sleeve opening on exposed uninsulated piping. Floor plates shall be split chrome plated cast brass similar to Ritter No. 36A.

2.7 VIBRATION ISOLATION

- A. Provide vibration isolators manufactured by a firm specializing in this type of work for equipment and piping that is capable of transmitting noise and vibration to the building structures.
- B. Isolators shall be designed to suit vibration frequency to be absorbed. Provide isolator units of area distribution to obtain proper resiliency under machinery load and impact. Where unequal distribution of weight occurs, design isolators for uniform deflection under imposed load.
- C. Examine the contract drawings for sizes, horsepower, rotational speeds, equipment location, length of span between columns and beams and construction type to determine the isolator selection type and deflection required for each piece of mechanical equipment. Conform to the requirements of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook, "HVAC Applications", Chapter 48, "Sound and Vibration Control"
- D. Isolators of the same type shall be the product of the same manufacturer, Mason, Vibration Eliminator or Korfund.
- E. Mountings shall be of the types indicated below:
 - 1. Type A: Double deflection neoprene mountings shall have a minimum static deflection of 0.50". Metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for those areas where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang. Mountings shall be type ND or rails type DNR as manufactured by Mason Industries, Inc. Color code to indicate durometer.
 - 2. Type B: Spring type isolation shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. Mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of compressed height of the spring at rated load. Springs shall have a minim additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be type SLF manufactured by Mason Industries, Inc.
 - 3. Type C: Equipment with operating weight different from the installed weight and equipment exposed to the wind such as cooling towers shall be mounted on spring mountings as described in Type B, but a housing shall be used that included vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection and cooling tower mounts shall be located between the supporting steel and roof or the grillage and dunnage as shown on the drawings. The

installed and operating heights shall be the same. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operations. Mountings used out of the doors shall be hot dipped galvanized. Mountings shall be SLR as manufactured by Mason Industries, Inc.

4. Type D: Neoprene crossribbed or waffle pattern, 5/16 inches thick. Provide ¼ inch hot dipped galvanized steel bearing plates. Permanently identify durometer. Mason Industries, Inc. Type W.

F. Hangers shall be of the types indicated below:

1. Type E: Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30-degree arc before contacting the hole and short-circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30-degree capability. Hanger shall be type 30N as manufactured by Mason Industries, Inc.
2. Type F: Vibration hangers shall be described in Type E, but they shall be pre-compressed to the rated deflection to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of scale. Submittals shall include a scale drawing of the hanger showing the 30-degree capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
3. Type G: Vibration hanger shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30-degree arc before contacting the hole and short circuiting the spring. Springs shall have minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30-degree capability. Hangers shall be type W30 as manufactured by Mason Industries, Inc.

G. Horizontal thrust restraints shall be of the types indicated below:

1. Type X: Air handling equipment shall be protected against excessive displacement, which might result from high air thrusts in relation to the equipment weight. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad as specified for the mountings or hangers. The spring element shall be contained within a steel frame and designed so it can be present for thrust at the factory and adjusted in the field to allow for maximum of ¼" movement at start and stop. The assembly shall be furnished with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on

either side of the unit. Horizontal thrust restraints shall be WB as manufactured by Mason Industries, Inc.

H. Bases shall be of the types indicated below:

1. Type H: Provide integral structural steel bases. Bases shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump bases which may be 'T' or 'L' shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in mounting locations to provide a base clearance of one inch. Bases shall be type WFSL as manufactured by Mason Industries, Inc.
2. Type J: Provide rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12' unless specifically recommended by the base manufacturer for mass rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". Forms shall include minimum reinforcement consisting of half-inch bars or angles welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations. Height saving brackets shall be employed in mounting locations to maintain a 1" clearance. Bases shall be type KSL as manufactured by Mason Industries, Inc.

I. Roof bases shall be of the types indicated below:

1. Type Y: Curb or dunnage mounted rooftop air handling equipment shall be mounted on vibration isolation rails that fit over the roof curb under the isolated equipment. The extruded aluminum top member shall overlap the bottom member to provide water runoff independent of the sea;. The aluminum members shall house cadmium plated springs having a 1" minimum deflection with 50% additional travel to solid. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a means of resilient snubbers in the corners with a minimum clearance of 1/4" so as not to interfere with the spring action in high winds. The weather seal consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible duct-like EPDM connection joining the outside perimeter of the aluminum members. Foam or other contact seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum. Submittals shall include spring deflection, spring diameters, compressed spring height and solid spring height as well as seal and wind resistance details. Isolation rails shall be Type KSR 2.0 as manufactured by Kinetics. Where vibration isolation rails are provided for insulated roof curbs, provide insulation of the same R-value for the isolation rails as is present for the roof curb.

- J. Pipe anchors shall be of types indicated below:
1. Type N: Provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1 inch thickness of heavy duty neoprene and duct or neoprene isolation materials. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material and shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. Deflection shall be a minimum of 1". All directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
- K. Pipe connectors shall be of types indicated below:
1. Type K: Flexible wire reinforced butyl or neoprene hose with integral elastomer and duct flanges and iron back-up rings, control cables with isolating bushings and washers and flange brackets to limit expansion. Length: 6 times diameter up to 36" maximum 150 psi working pressure at 250 degrees F, suction service working pressure 200 psi at 100 degrees F. Mason Industries, Inc. Type MTBF.
 2. Type L: Flexible bellows type bronze hose with bronze braid, sweat connections. Length: 8 times diameter, 10" minimum. Suitable for freon refrigerant service. Compressor discharge servicing working pressure 200 psi at 100 degrees F. Mason Industries, Inc. Type BSS.
- L. The first three pipe hangers in the main lines near isolated mechanical equipment shall be supported with hangers as described in Type F. Horizontal runs in other locations in mechanical rooms and equipment rooms shall be isolated by hangers as described in Type E. Floor supported piping shall rest on isolators as describes in Type C. Heat exchangers shall be considered part of the piping run. Type F hangers or the first three type C mounts as noted above will have the same static deflection as specified for the mounting under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 1" deflection for pipe sizes up to and including 3", 2" deflection for pipe sizes up to and including 6", and 3" deflection thereafter. Other hangers are mounts shall have a minimum steel spring deflection of 1". Hangers shall be located as close to the overhead supports as practical.
- M. Piping risers shall be suspended from or supported by Type F Hangers or Type C mountings and the piping anchored or guided with Type N anchors. Steel spring deflections shall be minimum of 1" except in those expansion locations where additional deflection is required to limit deflection or load changes to plus minus 25% of the initial stress.
- N. Duct discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type G hangers or Type C floor supports. Spring deflections shall be a minimum of 1".
- O. Provide vibration isolation as required above and as indicted in the following schedule:

EQUIPMENT	LOCATION	ISOLATIION	
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		TYPE	DEFL. (IN)
Roof Mounted Condensing/Heat Pump Units		A	1.0"
Rooftop Air Handling Units		Y	2.0"
Indoor Air Handling Units		B – Floor Mounted E – Suspended	1.0"
Inline Centrifugal Fans		E, X	1.0"

2.8 ACCESS PANELS

- A. In general, valves, dampers, traps and equipment shall be accessible through the removable panels in the ceiling. Where ceilings are not removable and in walls where access is required for service, access panels shall be provided. Access panels shall be appropriate for the finish in which they are installed, with a fire rating to match the wall or ceiling in which they are installed.
- B. Group valves, dampers and equipment together to keep the required number of access panels to a minimum.

2.9 ELECTRICAL WORK

- A. Motors and heating elements for equipment specified under the mechanical Sections of the Specifications shall be provided with the equipment.
- B. Starters, disconnect switches, and work pertaining to equipment power connections are specified under Division 26 unless specified with the equipment of this Division of the Specifications. Electrical devices provided under this Division shall meet requirements for similar equipment specified under Division 26.
- C. Interlock wiring, and the provision of pilot devices such as push buttons, thermostats, flow switches and similar items and their related wiring associated with the Automatic Control System, shall be provided in accordance with the applicable requirements of Division 26. For ease of servicing, permanently identify both ends of conductors with W. H. Brady Co. self-sticking Perma-Code wire markers. Mark control diagrams accordingly.
- D. Coordinate control device voltages.
- E. Unless specifically noted otherwise, motors $\frac{1}{2}$ HP and over shall be wound for 208 volts, 3 phase, 60 hertz current, and those under $\frac{1}{2}$ HP for 120 volts, single phase, 60 hertz current. Motors shall be equipped with grease packed ball bearings. Motors shall be rated for continuous duty at 100 percent of rated capacity with an ambient temperature of 40 degrees C.
- F. Design motors in accordance with NEMA standards and affix to each a nameplate accurately listing pertinent data. Motors shall have sufficient capacity to start and

operate the machine they drive without exceeding the motor nameplate rating at the speed specified or at speeds or loads, which may be obtained, by the drive actually furnished. The motor HP or KW ratings are those estimated to be required by the driven equipment when operating at specified duties and efficiencies and are used to determine electrical feeder sizes. If the actual horsepower or KW required for the equipment to be furnished is greater than the indicated horsepower or KW, it shall be provided. Changes required in starter, feeder, branch circuit or other electrical items shall be made. Provide a shop drawing showing the mechanical/electrical coordination between trades. The shop drawing shall list all mechanical equipment with power demand, associated branch circuit feeder designation, conduit and wire size, breaker size and fused safety switch.

- G. Unless otherwise indicated, polyphase motors shall be Class B, general purpose, squirrel cage, single speed, open induction type, stamped with NEMA Class B letter designation.
- H. Single phase motors except as noted shall be open, capacitor start type. Motors 1/6 horsepower and under shall be permanent split capacitor type with built-in reset thermal overload protection, unless specifically noted otherwise. Motors 1/12 horsepower and smaller that start with no load may be shaded pole with built-in reset thermal overload protection.
- I. Mechanical equipment with a factory wired control panel shall be wired in accordance with the National Electrical Code. Additionally, components within the panel shall bear the UL label.
- J. Motors 5 horsepower and over shall be provided with power factor correction devices to provide a power factor of 0.90 at design load.
- K. Equipment shall be UL listed as a system or be tested by an independent electrical testing agency acceptable to the Architect to comply with requirements of the Authority having jurisdiction.
- L. Do not install equipment, ductwork or piping in the dedicated spaces above switchgear, panels and transformers as identified in the National Electrical Code.

2.10 FLASHING

- A. Sanitary vent pipes passing through the roof shall be provided with conical neoprene boots for any pitch roof with base extending minimum of eight inches from vertical portion of boot. Provide clamp for securing boot to pipe.
- B. Flashing assemblies specified above shall be set in place as part of the work under this Division of this Specification, but will be finally installed as specified in another Division of this Specification.
- C. Base flashing of roof drains, ducts, fans and other equipment, if required, is specified in Division 7 of this Specification. Cap flashings shall be provided to make a water tight seal.

2.11 IDENTIFICATION

- A. Equipment shall be identified with engraved plastic laminate or anodized aluminum nameplates with pressure sensitive backing. Plates shall also be provided with drilled holes and fastened to equipment with moly-rivets. Letters shall be at least 3/8 inch high and larger in proportion to the size of the piece of equipment. Identification shall be the same as noted on schedules on the Drawings. Labels shall be provided for the following equipment.
 - 1. Rooftop Units
 - 2. Split System Heat Pumps
 - 3. VAV Boxes
 - 4. Exhaust Fans
- B. Labels shall identify the piping system. Labels shall be located where pipes enters and leaves a space and at 30 foot centers on normal runs. Duct systems shall be similarly identified by noting the system and direction of flow.
- C. On valves, except immediately adjacent to equipment, provide 1 inch diameter brass tag with embossed and painted black numbers to identify the valve. Tag numbers shall be coordinated between trades. Tags shall be attached to valve wheels with a brass link. Tags shall be manufactured by Brady, Seton Nameplate, or Wilmington Plastics.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

- A. Visit the site and become familiar with existing conditions. Modifications to work required to allow for existing conditions shall be provided. Submit proposed modifications to the Architect for approval prior to installation.
- B. Relocate existing hangers and supports where necessary to install new work. Maximum spacing requirements shall apply for relocated supports.
- C. Coordinate interruptions in service of existing systems with the Owner. Provide temporary connections to maintain operation of existing systems.

3.2 MANNER OF INSTALLATION

- A. Piping and ductwork shall be installed to preserve access to valves, dampers and equipment. Valves, dampers and equipment which require frequent service, adjustment or control and which cannot be located in a readily accessible and safe place, shall be provided with extension devices and remote operators, as necessary and as accepted for use by the Architect.
- B. Piping and ductwork shall be run to follow the lines of the building and to allow the maximum headroom consistent with proper pitch. Piping subject to thermal expansion shall be arranged to permit movement without damage to the piping, ductwork and equipment.
- C. The Drawings are generally indicative of the work to be installed, but they do not show all offsets, fittings and similar details required, which shall be provided to

meet the job conditions. In areas where work is installed in close proximity to work of other trades or within trades covered by this Division of the Specifications, prepare larger scale drawings consisting of plans and sections to show how work is to be installed in relation to work of other trades.

- D. Equipment and systems shall be installed in accordance with the requirements and recommendations of the associated manufacturer.

3.3 EXCAVATION AND BACKFILL

- A. Provide excavation and backfill necessary to install underground piping and other work included in this Division of the Specifications. Establish lines and grades required for the proper location of the work.
- B. After the piping has been placed, the trenches shall be backfilled to the lines of present grades or finished grade as required. No backfill shall be placed, however, until water has been removed from the trenches and joints have been set and also after the tests have been made on piping as required.

3.4 RECORD DRAWINGS

- A. Keep at the site two (2) sets of black and white prints for the express purpose of showing changes from the contract Drawings made during construction. Mark up the prints with red pencil during construction and deliver the prints, before final inspection, to the Architect as a final set of "Record Drawings". Refer to Division 1 for additional requirements.

3.5 CLEANING OF SYSTEMS

- A. Dust shall be removed from ductwork before Substantial Completion. Filter media shall be new at Substantial Completion.
- B. If systems become stopped with refuse, remove the obstruction and replace and repair work disturbed.
- C. Dust in the construction area shall be suppressed with wetting agents or sweeping compounds. Dust shall be cleaned regularly.
- D. Remove rust and clean surfaces to be insulated or painted.
- E. Leave systems in clean condition and running order.

3.6 PAINTING

- A. Remove rust, scale, grease, and dirt from equipment and material and leave ready for finish painting. Equipment specified with factory baked enamel finish shall be touched up as required to provide a surface visually free of scratches, nicks and blemishes.
- B. Paint uninsulated ferrous piping, hangers and miscellaneous iron work in concealed spaces with one coat of Rust-O-Leum dampproof red primer.

- C. Where metal duct is visible through a register or grille, paint the interior of the duct with flat black paint.

3.7 OPERATING AND MAINTENANCE MANUAL

- A. Submit operating and maintenance instructions. The manual shall include the following:
 - 1. A brief description of systems and their various components.
 - 2. Full, definite and explicit instructions for starting, stopping, controlling and changing over systems from one season to another.
 - 3. List of manufacturer's representatives with address and telephone numbers.
 - 4. Manufacturer's printed operating and maintenance instructions, parts lists, illustrations and diagrams for pieces of equipment.
 - 5. A complete schedule of periodic servicing and lubrication requirements for equipment.
 - 6. One copy of each shop drawing and Contractor's drawings.
 - 7. One copy of other items of equipment where not required as a shop drawing submittal.
 - 8. One copy of each wiring diagram.
 - 9. Motor manufacturer's certificate for motors exposed to the weather.
 - 10. The field test data specified in Section 230000 under Balancing and Adjusting.
 - 11. Sterilization certificate for domestic water systems.

3.8 FIELD INSTRUCTION

- A. Upon completion of work, furnish services of a competent representative to instruct Owner's representative in the proper operation and maintenance of elements of the mechanical systems. Submit instructor's name and credentials to the Architect for approval.
- B. Spend not less than 24 hours in such formal instruction to prepare Owner to operate and maintain the systems.
- C. At least 8 hours of the specified 24 hours of instruction shall occur after thirty days operation by Owner's representative and may be divided into periods of 8 hours at different seasons of the year.

3.9 PERFORMANCE TEST

- A. Should the performance or capacity of the systems, equipment or devices furnished be questioned by written notice from the Architect after installation, provide necessary test equipment and complete a satisfactory test of the items in question. The test shall be run when and as directed by the Architect and in the presence of his representative. Should the items furnished not pass such a test, they shall be removed and replaced by systems, equipment or devices satisfactory to the Architect.

END OF SECTION